Nanotechnology Education in Taiwan

Prof. Chyanbin Hwu

Department of Aeronautics and Astronautics,
National Cheng Kung University
Tainan, Taiwan, R.O.C.
Outline

- Project goals
- Project organization
- Project contents
- Executive results
- Economical outcomes
- Future works
Project goals

- Promote life-long learning in Nanotechnology Education
- Promote the popularization of Nanotechnology Education
- Upgrade the higher professional education, K-12 education and accomplishment education of science of the general public
- Narrow down the gap between city and rustic area and reduce the disparity of resources deployment
Project Title: Nanotechnology Human Resource Development (NHRD) Program, Ministry of Education

PI and Co-PIs:
- 2006- present: PI: C. Hwu, Co-PIs: W.B. Young, C.L. Chen

Organization:
- 2003-2005: Institute of Applied Mechanics, National Taiwan University
- 2006- present: Department of Aeronautics and Astronautics, National Cheng Kung University


Budget for each year:

<table>
<thead>
<tr>
<th>Year</th>
<th>Budget</th>
<th>(US$ in parenthesis)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003</td>
<td>NT$21,895,000</td>
<td>US$663,484</td>
</tr>
<tr>
<td>2004</td>
<td>NT$50,000,000</td>
<td>US$1,515,151</td>
</tr>
<tr>
<td>2005</td>
<td>NT$68,951,000</td>
<td>US$2,089,424</td>
</tr>
<tr>
<td>2006</td>
<td>NT$78,865,000</td>
<td>US$2,389,848</td>
</tr>
</tbody>
</table>
Project organization -3/3

- Regional Center for Advanced Nanotechnology Education
  - North, NTU, Taipei
    - 12 partner universities
  - Mid-North, NTHU, Hsin Chu
    - 10 partner universities
  - Mid-South, NCHU, Taichung
    - 16 partner universities
  - South, NCKU, Tainan
    - 15 partner universities
  - East, NDHU, Hwalian
    - 5 partner universities

- Regional Center for K-12 Nanotechnology Education
  - North, NTU, Taipei
    - 17 leading schools, 202 seed teachers
  - Mid-North, NTHU, Hsin Chu
    - 6 leading schools, 1049 seed teachers
  - Mid-South, NCHU, Taichung
    - 12 leading schools, 642 seed teachers
  - South, NKU, Kaohsiung
    - 15 leading schools, 878 seed teachers
  - East, NDHU, Hwalian
    - 13 leading schools, 173 seed teachers
Locations of Regional Centers

PO : NCKU

NTHU Hsinchu
Mid-north

NCHU Taichung
Mid-south

NCKU Tainan
South

NTU Taipei
North

NDHU Hualien
East
NHRD Program Office
- Integrate all works of advanced education centers, K-12 education centers and E-knowledge exchange platform
- Edit teaching materials of nanotechnology
  - Books for university students
  - Books for K-12 teachers and students
  - Multi-Media interactive CDs for K-12 students
  - Translation of published books or CDs
    - Chinese to English or Japanese, English to Chinese
- Hold national workshops for K-12 education, university student competition, etc.
- Establish international collaboration
  - Exchange of K-12 experience; exchange of university students
  - Attend International Nano Tech Exhibition
- Manage administrative works between Ministry of Education and all regional centers
Project contents – 2/4

- Regional Center for K-12 Nanotechnology Education
  - Training of K-12 seed teachers by offering lectures, workshops, lab training courses such as AFM, etc.
  - Edit teaching materials of nanotechnology
    - Books for K-12 students (of elementary, junior high and senior high schools) including comic books and text books
    - Multi-Media interactive CDs for K-12 students, such as animated cartoon, flash and powerpoint files, webpage design, videos for hands-on experiments, etc.
    - Teaching plans for K-12 teachers
  - Extension education by K-12 leading schools
    - Hold K-12 summer camp, circulating exhibition of mobile museum
    - Extend to students in suburban areas.
  - Establish online nanodictionary – Chinese/English/Japanese
  - Collaboration with museums such as National Taiwan Science Education Center, National Museum of Natural Science, and National Science and Technology Museum to popularize the nanotechnology to the general public
Regional Center for Advanced Nanotechnology Education

- Offer nanotechnology curriculum (credit hours for a series of course works)
- Offer non-credit certification nanotechnology courses, science-camps, lab and hands-on training, equipment operation courses, summer school, etc.
- Establish distant learning system for nanotechnology
  - Extend to the universities that have not enough professors and facilities for nanotechnology education – cross-university program
  - Motivate E-learning courses to free the time and space constraints
- Hold academic workshops, university-industry workshops, lectures, competitions, summer camps, etc.
- Support K-12 education centers with human and equipment resources
E-Knowledge Exchange Platform

- Integrate and display the achievements of all education centers
- Exchange information among centers
- Establish E-learning platform
- Publish Nano News Letters
- Connect all related networks of nano education and research
- Hold on-line creative idea competition for students
## Executive Results

- **Table of executive contents – K-12 Nanotechnology Education**

<table>
<thead>
<tr>
<th>K-12 Nanotechnology EducationTeam</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>universities</td>
<td>11</td>
</tr>
<tr>
<td>leading schools</td>
<td>92</td>
</tr>
<tr>
<td>K-12 active seed teachers</td>
<td>622</td>
</tr>
<tr>
<td>K-12 potential seed teachers</td>
<td>1180</td>
</tr>
<tr>
<td><strong>Publications</strong></td>
<td></td>
</tr>
<tr>
<td>books, cartoon, lesson plans, lecture notes subsidiary materials</td>
<td>192</td>
</tr>
<tr>
<td><strong>Activities</strong></td>
<td></td>
</tr>
<tr>
<td>conferences</td>
<td>3  ( ~700 participants)</td>
</tr>
<tr>
<td>seminars, competitions, exhibitions, workshops, speeches</td>
<td>58  ( ~4800 participants)</td>
</tr>
</tbody>
</table>
## Executive Results

- **Table of executive contents – Advanced Nanotechnology Education**

<table>
<thead>
<tr>
<th>Nano-science and technology Program</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>programs offered</td>
<td>13 universities</td>
</tr>
<tr>
<td>students enrolling in nanotechnology programs</td>
<td>2574</td>
</tr>
<tr>
<td>students completing nanotechnology programs</td>
<td>232</td>
</tr>
</tbody>
</table>

**Publications:**

| handouts/lecture notes | 40 |

**Activities**

| training courses for equipment user | ~3700 participants |
| national competitions, exhibitions, conferences | ~24000 participants |
Executive Results - K-12 Nanotechnology Education

- Cosmic books for students in elementary schools
  - Nano Blaster Man

- Animated Cartoon for students in elementary and junior high schools
  - A Fantasy Journey for Nana and Nono
  - Nano Magic
Executive Results - K-12 Nanotechnology Education

- Text books for students in senior high schools
  - Nano-Symphony

- Text books for K-12 teachers and university students
  - Nanotechnology – Fundamental, Application and Experiment
Executive Results - K-12 Nanotechnology Education

- Books under preparation
  - *Explore Prey*

- Text books for students in elementary schools, junior high schools and senior high schools
Executive Results - K-12 Nanotechnology Education

- **Experiment Kits**
  - *Synthesis of II-VI Quantum dots*
  - *Synthesis of nano-gold*
  - *Synthesis of nano-magnetic particles*
  - *Biomedical application of nano-magnetic beads*
  - *Fabrication of solar cell using TiO2*
  - *Carbon nano-tube model*
  - *Self-assemble of Poly-Styrene spheres*
  - *Fabrication of liquid crystal display*

- **Experiment Illustration DVD**
Executive Results - K-12 Nanotechnology Education

- Nanodictionary Online
  - Chinese/English/Japanese Collection: 450 new words with clear definition
  - Search system:
    1. Look up meaning in Chinese by English.
    2. Look up all lexicons which contains the input fragment of a word.
    3. A per word in dictionary homepage.

- Nano Topics Map
Executive Results - K-12 Nanotechnology Education

- AFM Laboratories

- Nanotech Classes and Summer Camps
Executive Results - K-12 Nanotechnology Education

- Lab Tour
- Nanotech Game
- Nano Little Pioneers
Executive Results - K-12 Nanotechnology Education

- Mobile Museum
  - National Taiwan Science Education Center
Executive Results - K-12 Nanotechnology Education

- Lectures for the general public

- Annual Conference for Seed Teachers
Executive Results - K-12 Nanotechnology Education

- Collaboration with Museums
  - National Nature Science Museum
  - National Science and Technology Museum

- Exhibitions
- Lectures
- Science competition
Executive Results – Advanced Nanotechnology Education

- Nano Science and Technology Program - undergraduate and graduate courses
- Nanoscience Lab Program
- Nano-Electronics Program
- Cross-University Program
- Summer School Program
- Distant Learning Program
- Nano Material Program
- Interaction with Industry
- Conferences and Workshops
- National Competitions on Nanotechnology and Nanoscience for college students
Executive Results – international collaboration

- **International Exchange Programs**
  - 2 graduates from USA → Taiwan
  - 6 graduates from Taiwan → USA, France, Singapore

- **International Relations**
  - **Northwestern University**
    - Prof. R. P. H. Chang, National Center for Learning and Teaching in Nanoscale Sci. and Eng. (NCLT)
  - **Arizona State University**
    - Prof. B. L. Ramakrishna, Interactive NanoVisualization for Sci. and Eng. Edu. (INVSEE)
  - **University of Wisconsin, Madison**
    - Prof. W. C. Crone, Mat'l's Research Sci. and Eng. Center (MRSEC)
  - **Ohio State University**
    - Prof. L. J. Lee, Ohio Center for Multifunctional Polymer Nano-mat'l's and Devices (CMPND)
  - **The NanoTechnology Group Inc.**
    - J. L. Feather
Executive Results – international collaboration

- Nano Tech Exhibitions
  - Nano Tech 2004, Taiwan
  - Nano Tech 2005, Japan
  - Nano tech 2006, Japan
Executive Results –
E-knowledge Exchange Platform

http://www.nano.edu.tw
Economics outcomes

- **Academic or Technological Efficiency**
  - Nurture professional human resource with capability to research and innovate

- **Social Efficiency**
  - Strengthen popular science education in nanotechnology

- **Economic Efficiency**
  - Decrease the cost of human resource development effectively
Future Works

- E-learning courses
- Distant learning
- Nanotechnology Elite Scholarship Program (NESP)
- Promoting collaboration between academic institutes and industry
- Publications internationalization
- International collaboration
- Transferring K-12 teaching materials to school curricula
Thank You!