Establishing A Country-wide Image Display Program for Engineering Education

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Abstract - Industries and markets of flat panel displays are emerging for the upcoming digital television era and increasing replacement of long existing, conventional cathode ray tube (CRT) televisions sets. Leveraging existing semiconductor industry, the vision of Taiwan government is to achieve one trillion NTD in total production revenue in 2008. Technological advancement and national competitiveness rely heavily upon trained personnel. Funded by the Ministry of Education in Taiwan, R.O.C., the national education program of image display (NEPID) was thus established in 2004 to nurture skilled personnel and to rapidly meet the urgent demand from professional enterprises on effective human resources. There are two specific goals. The first was to develop curricula and course materials, and the second was to promote collaborations between academic institutions and industries.

The field of image display requires multi-disciplines. The NEPID held various activities including cultivation of total 223 seed professors, establishment of 20 curricula and 9 subject courses, 8 synchronous distant learning, and hands-on contest and research competition of university-industry collaboration. The collaboration has been successfully made through hands-on research contests held for two years, fully supported by the top two LCD (liquid crystal display) manufacturers in Taiwan. The research contests have been highly recognized by participants of more than 150 undergraduates and graduates each year. With the educational activities and mechanism, the program has been proven to spread out a country-wide education on image display in Taiwan.

Key Words- flat panel display, national educational program, university regional center, distant learning.

I. INTRODUCTION

The Taiwanese government has formulated her "Two-Trillion and Twin- Star Industries Development Plan", and established the strategic directions for the country's core and emerging industries. The Ministry of Economic Affairs of Taiwan planned that production value for the semiconductor and TFT-LCD (Thin Film Transistor liquid crystal Display) industries both surpassed NT$1 trillion in 2006. One of the most critical criteria to meet this high production value has been the manpower supply for the optoelectronic industry, because there is no specific undergraduate optoelectronic program in the University education system. The total manpower from normal optoelectronic education program is far below the demand of display-related industries. The manpower educated from other engineering departments fails to meet the demand of the optoelectronic industries. Hence, the manpower development of image display program is crucial for the success of the TFT LCD trillion plan and overall optoelectronic industries in Taiwan.

In order to strengthen the foundation of Taiwan's image display technology education and supply qualified engineers for urgent needs of industries, Ministry of Education (MOE), Taiwan, initiated a five-year national innovative education program on image display technology. The program is intended for developing both undergraduate and graduate curricula as well as course materials to enhance the image display education. Meanwhile, the program office promotes collaborations between universities and industries to offer expertise to students for meeting the needs of industries and raising competitiveness of technical manpower.

II. PROGRAM STRUCTURE AND MANAGEMENT

The nationwide image display program office was established in 2004. The program office was located in the department of Electro-optical Engineering, National Taiwan University of Science and Technology in Taiwan. The program is intended for developing both undergraduate and graduate curricula as well as course materials to enhance the image display education. Meanwhile, the program office promotes collaborations between universities and industries to offer expertise to students for meeting the needs of industries and raising competitiveness of technical manpower. The goals are set to

(1) train up to 250 prospective lecturers who can offer courses in display technology to students in their colleges and universities;
(2) offer at least 100 courses in alliance with industries to

improve the training;
(3) generate at least 100 patents related to display technology;
(4) train up to 2500 mid- and high-level engineers;
(5) initiate 100 projects of academy-industry collaboration; and
(6) build up a Web-based information exchange platform.

The program is supervised by the advisory office of MOE and an advisory board that includes 12 members from leading research institutes and companies on image display. The program office set up 7 regional education centers across the Taiwan Island and an electronic information exchange platform (www.fpd.edu.tw) for display technology as shown in Fig. 1. The advisory board provides guidance and consultation for the program. The committee members also review midterm and annual reports from the education centers and various working items. The program office provides administrative services for all the education centers, the partner schools and plans for national events and activities. The education centers develop the image display education programs and serve as the regional resources and/or equipment centers for the partner schools.

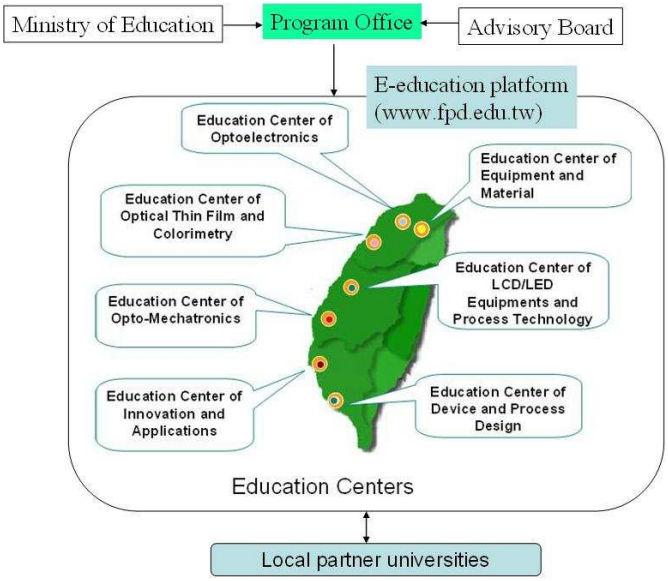

Fig. 1 Structure of image display program

A. Regional Education Center and Partner Universities/Colleges

To effectively achieve the goals, the NEPID constructed a program structure of seven regional university centres that were geographically distributed all over the entire island. Each regional education centers of partnership with neighbouring colleges/universities was unique, based upon local resources and core competence. They are characterized as education centers of Optoelectronics, Equipment & Materials, Optical Thin Film and Colorimetry, LCD/LED Equipments and Process Technology, Opto-Mechatronics, Innovation & Applications, and Device & Process Design. There were totally 40 universities with partnership that joined seven regional university centres. In addition, the NEPID supported seven regional centres to establish local common laboratories of resource sharing for an encouraging and effective educational environment.

B. Web-based e-Education Information Platform

In program structure for virtual information communication between university regional education centres, the web-based e-education information platform for image display was needed for integration to provide information exchange, internet platform, and resource sharing of course materials. In addition to the websites constructed by locally regional education centers, the web-based e-education information platform provides a virtual integration of resource sharing and common information including news & job announcements, newly technological development, spreading of pubic science and technology of image display, video on demand (VOD) on learning, monthly e-newspapers, course materials, speech & seminar multimedia materials, and e-learning. As a result, the e-education information platform may greatly reduce significant effort on similar equipment setup and duplication of similar software and contents. Moreover, because learning on VOD and e-learning may consume bandwidth greatly, three local divisions of the e-education information platform geographically distributed all over the entire island were also constructed. As a result of distributed extension, the hurdle of bandwidth on e-learning can be practically resolved.

C. Internal Program Evaluation

The program office encourages the education centers to hold education-related events with core competence of centers, and to develop unique measures for enhancing education in display technology. An evaluation system was set up so that integration of resources can be efficiently managed. The program office provided a form of qualitative and quantitative items for evaluation. Based on the midterm on-site visit and final review, the scores of evaluation to regional education centers provide a funding reference in next fiscal year. Meanwhile, the ratio is 30% for the midterm on-site visit, and 70% for the final review.

D. Learning organization

In 1990, Peter Senge proposed the fifth discipline and learning organization that emphasized continuous improvement with a commitment to learning [1]. In the beginning of the year, one regional education center was assigned by the program office to hold an event to demonstrate the core competence in education activities on curricula, lecture, experiment and research of flat panel display-related science and technology. All other regional centers were invited to participate in the event and to share the experience and information that the center was built. In 2006, the education center of Device and Process Design in National Kaohsiung University of Applied Sciences in soutern Taiwan held the event titled with “Value Promotion with Technology Integration – LCD Backlight Modules As A Vehicle”. The center demonstrated the common laboratory of

resource on campus, virtual monitoring on multiple laboratories, curricula, hands-on experiments, course and e-learning materials. All were impressively coherent in line with the knowledge, information and practice of LCD backlight modules. In the course of preparation for this event, the host center endeavored for integration of all school resources together and sharing with her partner universities and colleges. The rest of education centers also witnessed the event and shared the experience of successful integration.

III. HUMAN RESOURCE CULTIVATION

One of the goals in this program is to fill the demand-supply gap of manpower shortage between universities and display industries. However, the course scope for image display in science and technology requires inter-disciplines, which includes domain fields such as electro-optical and electric engineering, information science, mechanical engineering, material science, and chemical engineering. The program sets up a funding policy to catalyze multi-disciplines of curricula and courses. As a result, new engineers from universities are trained with solid and robust background. There were five measures adopted by the program office and the seven regional educational centers. These measures are as follows.

A. Joint Laboratories among Regional Education Centers and Their Partner Universities/Colleges.

Seven major joint laboratories for teaching and 37 their subsidiary laboratories have been set up in the regional education centers. This measure results in nationwide use of the facilities among the universities, colleges, and research institutes in Taiwan. The statistical data from the 7 regional education centers show 10,489 person-times on conducting research and 25,717 person-time on lecture. In 2006, the MOE funded 16 universities in total $350,000 for establishing the laboratories. Based on this funding, these universities/colleges are able to collect other funding from outside resources about $5,700,000. The remuneration rate is around 16 times.

B. Providing Course Curricula and Long-distance Teaching and Generating Best Teaching Materials

In order to train students with solid and robust background, the program office issued some core courses related to display technologies, and MOE encourage and fund universities/colleges to offer these or related course to students. Experts from the industry are invited to develop course materials with professors to train not only students but also engineers for the industry. Long-distance course teaching was also provided by some regional education centers as broadcast ends, and other universities/colleges interested this course can be as receiving ends.

Some statistical data are as follows：

- Display Curricula : 20 curricula related to display technology are offered, which include 241 courses. There are 28746 students involved, while 74 persons are qualified to earn certificates.
- Subject Courses on Display Science & Technology : 9 subject courses of display-related science and technology are offered. There are 420 students involved.
- Synchronous Distant Learning : 8 broadcasting courses are offered from three major universities, and 28 courses are newly created at received universities. There are totally 839 undergraduates and graduate students enrolled in class in 2006.

All of the teaching materials are evaluated. At most ten excellent materials are judged and rewarded. These materials can be accessed openly via our information exchange platform (www.fpd.edu.tw) by universities or industries.

C. Diffusion of Synchronous Distant Learning Program

There are two types of long-distance teaching, namely synchronous and asynchronous types. The synchronous type needs to gather all receiving-end universities to negotiate possible common broadcasting time slots, while the asynchronous type, a modified version of the synchronous type, teachers in the receiving end selects some core parts of the course from the broadcasting end and adds some additional materials by themselves, and edits a new version of teaching material. Meanwhile, Fig.2 shows the asynchronous material of multimedia interactive web-based learning that allows students to review the course material in post lectures.

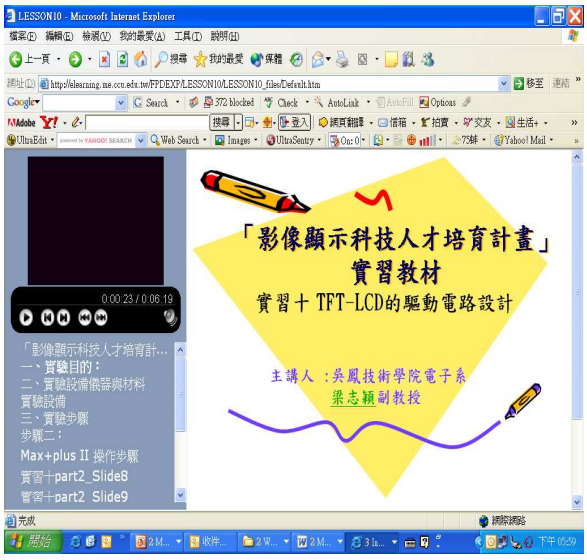

Fig.2 An example of multimedia interactive web-based learning

D. Hands-on-Contests On Human or Engineering Projects

One of the aims of these contest, is to enhance students' hands-on abilities. Large amount of awards are provided by

industry. Demonstrations or post sections are held in these contests. The industry provides practices and process training for students. By enhancing collaborations between universities and industries via this measure, we are able to reduce the discrepancy between the university education and the industry's needs. We are reported by the industry that many creative ideas are obtained via this exhibition.

E. Display Technology in K-12 Programs

This program was established to prepare a future generation of researches, engineers, designers, business leaders, and general public that support the development of display technology. This program focused on introducing high and junior high school teachers and students to recent research and development in display and related technology.

In 2006, the symposiums were held by 3 regional education centers, attracting 92 high school teachers and more than 6400 students involved. The results of this program are encouraging. First, many teachers found renewed energy for learning, searching for information, and creating materials for student learning. For students, LCD TV that they touched everyday is for that far away from them. The attitudes make students autonomous and confident on learning new technology.

IV. COLLABORATION OF UNIVERSITY AND INDUSTRY

In order to reduce the discrepancy between the university education and the industry's needs, the program emphasizes collaborations between universities and industries. The program office coordinated with domestic companies in display industry to release the resources into universities. The collaborations proceeded in two ways.

A. Hands-on Research Contest

The program office coordinated with the top two domestic companies to offer the award supports. Beginning in 2005, the AUO Award was first funded by the AUO Inc. Similarly, the Chi-Mei Award was offered by the Chi-Mei Inc. in 2006. The industry provides practices and process training for students. The champions were awarded with 1 million NTD (New Taiwan Dollars).

In 2005, 31 teams joined the contest, which involved approximate 150 students. In contest of 2006, total 36 teams were formed to join the competition, which accounted for approximate 180 students involved. The questionnaire described 96 % of participants who revealed wills for the concurrently undergone for future development. International visits to renowned institutes, universities and incorporations were one of the major tasks to enhance global contact and interaction. In 2005, the visit was focused in Asia, including Korea and Japan where they have been the major players in flat panel display industries. The visit to the institutes in Unite State was made in 2006. The task of visit was focused on the institutes where the model on research & technology transfer from universities to same competition again. With such a mechanism of hands-on research contests, the collaboration was proven to be impressively successful for both academics and industry. The program office gained positive feedback from students and companies. It was found that engineering students offered innovations of research contests with the companies, as the companies released the state-of-art technology and existing technological bottlenecks to university students. This is a win-win situation of university-industry collaboration.

B. Innovative Exhibition Center

The program office encouraged regional universities to build up exhibition centers with unique feature of their own profession. The exhibition centers allow those whom are interested in to see practical samples relevant to display technology ranging from liquid crystal display, plasma display panel (PDP), digital light processing (DLP) projection, and organic & inorganic light-emitting diode (LED)-based display. By sponsoring a minor support on centers and weighing evaluation of regional universities, four innovative exhibition centers are formed in universities, which exhibited a collection of various displays, components, modules, equipment, or advanced products of future applications. Based upon the core profession of team members and relationship with local companies, exhibition centers presented features of core competence in a range of professions from materials & equipment, electro-optic thin film, large display, and innovation & application. Most of the proprietary are donated from companies. The interaction and relation with industry are encouraged to fulfill the achievement. Furthermore, experts from the industry were invited to develop course materials with professors to train not only students but also engineers for the industry.

V. ADVANCED PILOT EDUCATION

The program office serves as a hub combining various education resources from colleges, corporations, research institutes, foundations, and the government to accelerate the training of students, engineers, researchers, which brings Taiwan's local research & development to the international level.

A. International Visit

In addition to raising competitiveness of technological manpower and fulfilling the urgent needs of manpower in industry, the advanced education on image display has been

incorporations. That brings a model and demonstration of how the resources and research powers in universities are released into incorporations, bridging the gap between the innovation generated in universities and practical applications in industry.

B. Cultivation of Seed Lecturers

As we comprehend that the display technology is multi-disciplinary domain knowledge, the program focuses on the design of multi-disciplinary curricula and courses for training engineers with solid and robust background. The domain knowledge includes fields like electro-optical and electric engineering, information science, mechanical engineering, material science, and chemical engineering and so on. As a result, cultivation of seed lecturers in display technology is crucial not only for urgent needs to offer lectures to students as manpowers to industry, but also for seeds on advanced education and research potential. The seed lecturers are PhD level and professors in universities/colleges from various engineering professionals. The training program includes topics of LCD, PDP, projection, organic & inorganic LED, and flexible & 3D displays. Beginning in 2004, a series of programs on cultivation of seed lecturers were carried out in three years. There have been 223 professors trained in this program. Meanwhile, 78 courses were offered by trained lecturers, in which total 3247 students were enrolled.

VI. CONCLUSION

The results of the nationwide image display program are encouraging. First, the economic efficacy is significant. In 2006, one of the top display incorporations needed 500 engineers of job injection for expansion in next generation of LCD manufacturing. This yields significant economic contribution in job demand, and proper engineers to the target industry. In addition, the program funded common laboratories to 16 universities in $20 M (NTD) in two years. With appropriate mechanism and management, the universities applying for common laboratories are forced to share resources of existing facilities that are worth approximate $190 M (NTD). The sharing resources are tenfold in expansion. This reinforces communication and interaction between universities and colleges. Furthermore, four innovative exhibition centers located in regional education centers offers on-site visits of state-of-the-art display technology for resource sharing.

Second, bridging the gap between universities and industry by creating the innovative model of university-industry collaboration, the hands-on contest and research competition stimulate research activities toward the area in display technology. Offered by AUO Inc. and Chi-Mei Inc., the top prize of champion awards drives student passions for competition. As a consequence, this indeed raises research quality qualitatively and quantitatively.

Third, the nationwide e-education information platform provides a virtual integration of resource sharing and public information including news & job announcements, newly technological development, spreading of pubic science and technology of image display, video on demand (VOD) for learning, monthly e-newspapers, course materials, and speech & seminar multimedia materials. The e-education information platform also reduces significant effort on similar equipment setup and duplication of similar software and contents.

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REFERENCE

1. Peter Senge, The Fifth Discipline: The Art and Practice of the Learning Organization, ISBN 0-385-26095-4.
2. C-K. Lee, T.-T Wu, P.-L. Liu, and S. Hsu, “Establishing a K-12 Nanotechnology Program for Teacher Professional Development,” IEEE TRANS. On Education, vol. 49, No. 1, pp. 141-146, Feb., 2006.