Promoting E-Learning Courses in Aerospace Education in Taiwan

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Abstract *- This paper describes two distant-learning courses which are being promoted by Ministry of Education through a national program aiming to revitalize the university aerospace education in Taiwan, in order to respond to the trend of the manpower needs of the aerospace industry. These two courses, namely, "Picosat System Engineering" and "Introduction of Aviation Technology", will be taught by the specialists in the respective fields. Since the courses will be managed by the program office, instead of a university department, via internet communication, a number of issues which have not been encountered before are addressed and discussed in the paper.*

INTRODUCTION

Facing the manpower needs of the aerospace industry in Taiwan diversified into a wide range of areas in aircraft manufacturing, aviation and space technology, the universities and colleges in Taiwan are taking actions to revitalize their academic programs to respond to this trend. For those applied-oriented courses, the schools inevitably have to look for the qualified lecturers outside the campus. Hence, a problem immediately raised is concerning the availability of these lecturers, who are fully occupied by their professional jobs. This paper describes two distance-learning courses developed with the resources support outside the campus, representing an approach to resolve the problem mentioned.

In the conference of ICEE2001[1], the present authors gave an overview on a national program, currently supported by Ministry of Education, for the revitalization of aerospace education in Taiwan. This national program emphasizes the mechanisms of university-industry cooperation as well as international cooperation, to promote aerospace education in the areas of aviation maintenance, aircraft manufacturing, avionics and aerospace quality. The objective of this program is to encourage the universities and colleges to revitalize their academic programs to respond to the manpower needs in the aerospace industry. It should be mentioned that the current curricula of aerospace education seen in the universities mainly emphasize on the fundamentals of aerospace engineering, such as aerospace mechanics and aircraft design, whereas the needs of manpower in the aerospace market are pronouncedly tilted toward manufacturing, avionics, aircraft maintenance and space technology, which are more multi-disciplinary orientated. Hence, a gap between the university education and industrial needs calls for attention.

An infrastructure, called the university-industry strategic alliance, was established at the beginning of the execution of this project. This infrastructure consists of three levels, namely, the program office, the resources centers and the partner schools. The functions of each of the levels are briefly described below. The program office plays the role of managing the entire program, that is responsible for planning and reviewing the progress of all the working items of this program. At the level of resources centers, there are four resources centers established with respect to the areas of aircraft maintenance, aircraft manufacturing, aerospace quality assurance, and avionics, each of which plays the role of coordinating the resources in universities and industry, in order to develop new courses or improve the quality of the existing courses, and provide adequate training to the lecturers. It is realized that all the four areas described above are multi-disciplinary oriented, which were not commonly seen in a traditional aerospace curriculum. Also, it is clear that to develop these multi-disciplinary courses requires the resources more than those of which can be offered by a university department. Hence, a resources center shall take the lead to promote the cooperation between university and industry and make good use of the resources outside the campus, in order to develop the courses in the respective area. Apart from the resources centers mentioned, an international center for aerospace education was established under the program office, with a mission to promote the activities relevant to international cooperation. This center serves as a window of collecting and exchanging the information of aerospace education abroad, and helps the universities and colleges to develop the cooperative relations with foreign educational institutes. Speaking of the partner schools, they are referred to the ones which express their interests to participate in this program, most of which obtain the laboratory equipment funding from MOE. With the coordination efforts of a resources center, a partner school can have better opportunities to work with the industrial organizations to develop the new courses and set up the teaching laboratories. In summary, the merit of

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this infrastructure is that those multi-disciplinary, applied-oriented, courses which were not seen in the traditional curriculum of a university department can be established in a timely manner to respond to the trend of manpower needs in the local industry.

The current manpower needs in the aerospace industry in Taiwan can be largely categorized into two respects, namely, aviation and space technology. For aviation, the manpower needs are mainly due to the recent growth of domestic and international air transportation, as well as the growth of civil aircraft components manufacturing business in Taiwan. On the other hand, the manpower needs in space technology can be perceived from the recent development of the national space program. In the second fifteen-year plan of the national space program of 2004-2018, the national space program office clearly stated that more efforts will be deoted to develop the indigenous capability of satellite system design, integration and testing. This infers that more collaborative activities with domestic universities and industry shall be realized in the coming years. It can also be expected that more young engineers will be recruited by the national space program office and take part in the development of the satellite systems.

Perceiving the manpower needs in aviation and space technology, the program office announced two distant-learning courses, "Introduction of Aviation Technology" and "Picosat System Engineering", which will be offered this year. By live internet, these courses will virtually be open to all the students in the country. In the following, these two courses will be described. The issues arisen from the development of these two courses will also be addressed.

THE COURSE "INTRODUCTION OF AVIATION"

This course was motivated by the recent observation that a number of universities and colleges are interested in developing the courses in the field of aviation, on the other hand few qualified lecturers can be found among the faculty in these universities and colleges. Since the aviation technology encompasses various subjects in engineering, management, medicine, and regulations, it is almost impossible to find a lecturer who is qualified to cover such a wide range of areas. On the other hand, to provide students a comprehensive knowledge background of aviation is deemed very essential. Thus, a course at the entry-level, with the scope of introducing various areas of aviation, proposed here is meaningful, which can serve as a basic course for an aviation curriculum, currently under development in the universities and colleges.

This course will be offered by the Aviation Training Institute, Civil Aeronautics Administration (CAA). The institute is reputable for its capability of providing high-quality training courses for aviation professionals. For many years, this institute has been specialized in training the air traffic controllers. Recently, this institute also provide other training courses for the governmental employees who are required to have knowledge in aviation. As in CAA, this institute uniquely has the advantage to access the resources of aviation in the country. For instance, in a training course, the lecturers can be selected from the officers of CAA, who have many years of experiences on the course subjects. Moreover, the lecturing materials are kept well updated.

Preceding to this course, a five-day short course on an introduction of aviation technology was offered by the Aviation Training Institute last year, which was specially tailored for school teachers, based on the requests of the program office. The objective of the short course was to give the participants an overwiew on various areas in aviation. After the completion of this short course, the participants gave very high rating to the technical contents of the course, on the other hand a general comments noted was that the participants felt difficult to devote their time of five full days to attend the classes, especially for those who were not living in Taipei.

The program office and the Aviation Training Institute later realized that this problem could have been resolved by means of distance-learning, thus the participants would not have had to go to the institute for attending the classes. Coincidentally, it is very fortunate that the institute already have the internet teaching facility, which was designed for the training courses for the CAA personnels at different airports. This system is ideal for the present purpose. On the other hand, a multi-media laboratory for distance-learning education established in the Aerospace Science and Technology Research Center (ASTRC), National Cheng Kung University (NCKU), where the program office is based, can provide all the technical supports necessary for this course.

The concept of internet networking for this course can be shown schematically in Figure 1. Note that TANet represents the Taiwan Academic Network, which links all the academic institutions in the country into a system. Presumably, the lectures will be broadcasted from the Aviation Training Institute. The networking enables a student, who is physically at any one of the resources centers, interacting with the lecturer in a real-time manner. The live lectures will also be recorded and stored in a VOD (Video-on-demand) system at the Aviation Training Institute or ASTRC, shown in Fig. 1, therefore students can review the lectures at their convenience.

This course will be offered this summer, 48 hours in total, over a period of two weeks. The course outline is given below.

Aviation policy (4 hrs)
Flight safety and human factors (4 hrs)
Aviation medicine (2 hrs)
Aviation international affairs (2 hrs)
Introduction of flight (4 hrs)
Introduction of aviation regulations (4 hrs)
Airport planning (4 hrs)
Aircraft airworthiness (4 hrs)
Aviation meteorology (2 hrs)

Introduction of flight simulator using personal computer (2 hrs)
Introduction of air traffic control (2 hrs)
Navigation-aid facilities and maintenance (2 hrs)
Rules of flight (4 hrs)
Airport management (2 hrs)
Airport on-site visit (2 hrs)
Final test (2 hrs)
Discussion and Conclusion (2 hrs)

From the course outline above, one can see that the characteristics of this course are very different from those of a traditional aerospace engineering course. The noticeable features of this course are: (1) the subjects in the course contents cover a wide range of areas of aviation, (2) such a course is simply impossible to be taught by a single lecturer, and (3) no textbook is available from the shelf for this course. Since the contents of this course are defined at the entry level on aviation, any university undergraduates major in engineering or in the fields related to aerospace science and management are welcome to take this course. As mentioned, the scope of the course is to provide students a comprehensive knowledge background on aviation.

The students who are interested in this course should make registration to the program office directly. Hence, the program office will manage this course directly. On the other hand, this course needs a great deal of support by each of the resources centers. Specifically speaking, a resources center shall have a video classroom with the equipment necessary for live internet teaching, which will serve as a nodal point in the present networking, see Fig. 1. Moreover, the administration support of a resources center is deemed very essential, in order to take care of the student affairs and monitor the performance of the course works.

The program office will award a certificate to a student who has passed the final test and attended at least 80% of the lectures as required. However, the program office will not be able to award academic credits to a student, because a university department bears the authority.

THE COURSE "PICOSAT SYSTEM ENGINEERING"

To promote the space system engineering education, the National Space Program Office (NSPO) and the program office have signed an agreement of cooperation to jointly develop an one-year course entitled "Picosat system engineering", starting from the fall semester of 2002. This course can be regarded as a follow-up of the recent activity of NSPO on a picosat project named YAMSAT. The YAMSAT is 10 cm cube in dimension, one kilogram in weight, commonly called the cubesat in the space community. This satellite has already passed the integration test in NSPO, which will be launched via the foreign launching service later. Since the development of a picosat is at reasonably low cost, ideal for the purpose of education, NSPO would like to share the experiences of YAMSAT with the academic institutions. Having realized this, the present program made an announcement recently of this one-year course, that students can gain hands-on experiences through this picosat project.

The program office formed a planning committee for this course firstly. This committee consists of members of satellite specialists in NSPO, who have experiences of the YAMSAT project, and a number of university professors in this field. This committee will design and review the contents of the course, and conduct a series of review meetings for monitoring the progress of the project. This one-year course will be offered in the fall semester of 2002 and the spring semester of 2003. Furthermore, the subsystems will be assembled in the summer of 2003 at ASTRC, subsequently the final integration test will be conducted at NSPO, which will be completed by the end of 2003. According to the schedule, this picosat will be ready for launching in early 2004.

The main objective of this one-year course is to get students familiarized with the subjects of system engineering relevant to a picosat, subsequently involved in hands-on design and integration testing of a picosat. In the first semester, this course is formulated in a series of lectures, specially tailored for the design of the picosat . As far as the lecturing materials are concerned, instead of attempting to give a thorough introduction on space system engineering, the strategy adopted here is to put more weighting on the subjects, which have direct bearing on the present picosat system. For instance, the subjects of electronics and communication will be lectured in a more detailed manner, compared to those of structure and thermal control, since for the present satellite the later issues can be resolved with less efforts by referring to the existing design. In the second semester, this course will be focused on the hands-on practice with testing the satellite components and subsystems. The students will be divided into a number of teams with respect to different subsystems. Their assignments will be carried out in the laboratories, presumably supported by the universities participating in this project. Meanwhile, the specialists in NSPO will pay visits to these laboratories to provide guidance and advices to the student teams. Meanwhile, the program office will conduct meetings with the student teams and the NSPO specialists for reviewing the progress of the project.

In addition to the planning of the courses described above, NSPO and the program office jointly formed a task force to ensure that the integration test of the picosat can be successfully completed by the end of 2003. This task force comprises three groups, namely, (1) a group called the expert team, which is formed by the specialists in NSPO and the professors in universities who have experiences with the satellite design, (2) a group called the professional team, which consists of members of the university professors who are interested in involving in this project and the full-time engineers associated with the program office, and (3) the student teams mentioned above for developing the subsystems of the satellite. The

members of the expert team will give lecturers via internet, and provide guidance to the student teams throughout the phases of design and integration test of the picosat. The professional team will supervise the works conducted by the student teams, meanwhile may actively involve in the working items of the project, in order to assure the quality of the hands-on works. This task force is under the coordination by the program office, that a project manager has been assigned to manage the project.

The courses will be offered to the graduate and undergraduate (junior or senior) students major in engineering or physics. One may refer to the web page (www.iaalab.ncku.edu.tw/aepo/picosat/Outline. ppt) for the contents of the course, which are also briefly described below.

Chapter 1: System Engineering Process and Requirements
Chapter 2: Spacecraft Mission Design
Chapter 3: Space Powers
Chapter 4: Communication
Chapter 5: Configuration and Structural Design
Chapter 6: Attitude Determination and Control
Chapter 7: Thermal Control
Chapter 8: Flight Software
Chapter 9: Launch Vehicle

As mentioned, in the first semester this course will be taught via live internet. Similar to Fig. 1, Fig. 2 shows the networking structure for this course. Presumably, a lecturer can deliver his lecture at a nodal location, while a registered student can be present at any of the distant-learning classrooms linked by internet. Besides the lectures, the program office has to organize a number of meetings for the lecturers, supervisors, and students to discuss their design ideas and problems encountered. In addition, the present program office is going to set up a picosat system-engineering laboratory at ASTRC for testing the picosat components and subsystems. As planned, the satellite shall be assembled and tested at ASTRC in the summer of 2003, prior to the integration test at NSPO.

ISSUES OF CONCERN

Compared to a course traditionally offered in a university department, the present courses described above are noted somewhat different in the method of teaching, which is via live internet communication, the courses contents, and the management that the program office plays the role of coordinating the activities. Since these courses are realized as the first ones of this sort in the country, a number of issues encountered in the development of these courses are worthwhile to be addressed in the following.

1. Despite that the registration of these courses will be submitted by a student to the program office directly, the submission is required to be based on the permission of his department. This is mainly due to two reasons. First, it is clear that the program office would not have been able to monitor the performance of a student if there were no strong support of his department,. Second, concerning the credits recognition of these courses, it is clear that the department has the sole authority, not the program office. In fact, on the registration form, it is also required to have the information of a supervisor, presumably assigned by the department, whom will be contacted by the program office oftenly for monitoring the course works of the students. In fact, it is strongly encouraged that a department take the advantage of these two courses to integrate them into its academic curriculum.
2. Although there will be no registration fee for either of the courses, it should be pointed out that there are additional expenses associated with these courses, which should be taken care by the registered students and the departments. For instance, for the course “Introduction of aviation technology”, it is required that on the last day of the class, students have to be present at the Aviation Training Institute to take the final exam, and join in a site visit to an airport. The travel expense to the Aviation Training Institute should be taken care by each of the students. Similarly, in the course “Picosat System Engineering”, while the program office will provide the materials of the picosat to a student team, the department supervising this team has to provide the laboratory space and the testing equipment necessary for the team conducting the assignments. In fact, one of the criteria concerning the formation of a student team is to evaluate the degree of support endorsed by the sponsoring department.
3. Concerning the qualification of students taking these courses, there will be no special requirements on their academic background, but the students major in engineering or the fields related to aerospace would be preferred. Practically speaking, the registration will be open to all the students who are interested in the courses. On the other hand, evaluation on the course work of each of the students will be rigorous. A certificate will be awarded to a student only if he has passed the examination and fulfilled all the requirements.

CONCLUDING REMARKS

This paper describes two distance-learning courses on aerospace education, which will be offered to the students in Taiwan this year. As mentioned above, these courses have direct bearing on the recent development of the aviation and space engineering programs in the local universities and colleges. Moreover, it is pointed out that offering either of the courses is far beyond the capability of a single university department. Hence, the approach described in this paper is attempting to utilize the resources outside the university campus as well. In order to make this approach feasible, a good coordination between university, industry and governmental agency was realized to be very essential. Hence, an infrastructure, called the university-industry strategic alliance, took the lead to promote these courses, by integrating the efforts of the program office, the resources centers, the partner

schools, the Aviation Training Center, the National Space Program Office in an effective manner.

A distinct feature of these courses is that the lectures will be given by the specialists in the respective areas, who are not regular faculty members in universities. Fortunately, this is made possible with the support of the Aviation Training Institute and the National Space Program Office. In fact, these courses illustrate an accomplishment of the present university-industry strategic alliance, that the knowledge and experiences borne by the specialists outside the campus can be transferred directly to the students through these courses.

In addition to the support of the governmental agencies pointed out above, it should be mentioned that the supports by the partner schools and the resources centers are very important to the success of these courses. As pointed out, the registration application submitted by a student should be accompanied with the permission of his department, meanwhile the department should assign a supervisor to monitor the course works of the students. More importantly, a department bears the authority to award a student the academic credits for these courses.

The program office will conduct evaluations on the outcome of these two courses in 2003. Based on the evaluation data and comments, improvements on these courses will be made subsequently.

ACKNOWLEDGMENT

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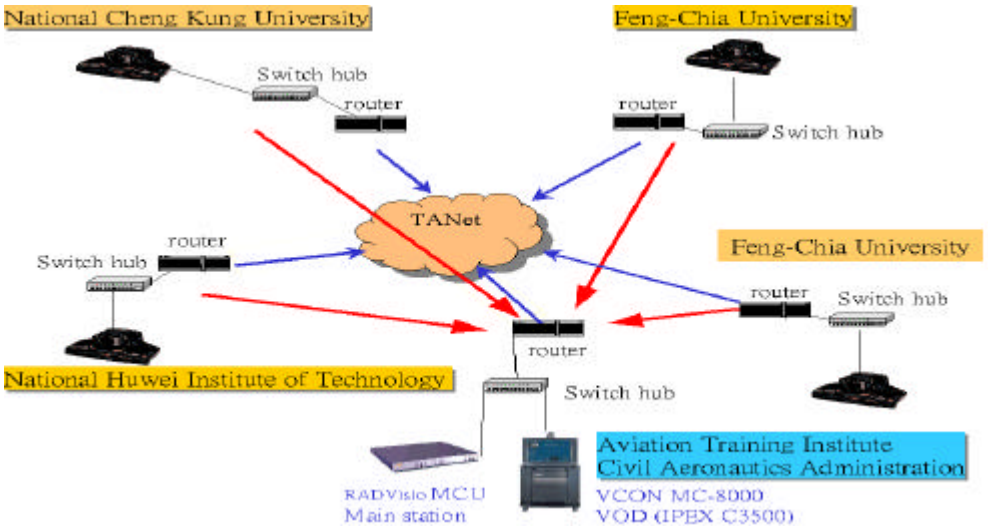

FIGURE. 1
Networking for the course "Introduction of Aviation Technology".

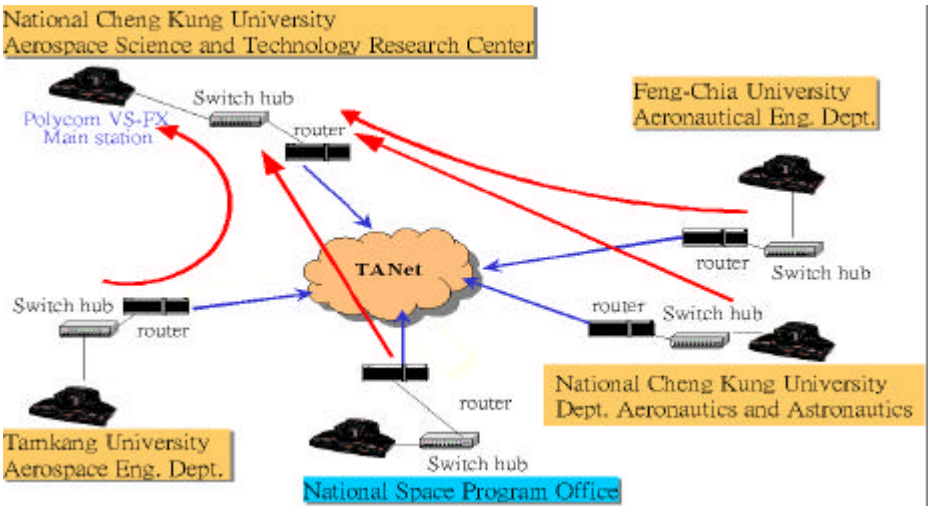

FIGURE. 2
Networking for the course "Picosat System Engineering".