

EXPERIENCE OF FIRST YEAR CDIO IMPLEMENTATION AT VNU-HCM

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ABSTRACT

Along with the development of economy and society, Vietnam is facing a challenge of training a skilled labor force. This requires improving the education system, especially higher education, to meet society needs. As a flagship and the largest university system in Vietnam, the Vietnam National University-Ho Chi Minh City (VNU-HCM) System has spearheaded many initiatives to improve the quality of education in Vietnam. A key effort in these initiatives is VNU-HCM's leadership in adopting and adapting CDIO principles to build a model framework for widespread implementation of CDIO in Vietnam. In this paper, we present the first year experience of implementing CDIO at VNU-HCM from the point of view of a system of universities and the achievements that we have accomplished. In particular, we discuss: (i) the lessons learned and the challenges in promoting cultural changes, in treating human as a the most valuable asset in bringing about changes, and in sharing and disseminating our work within our university system and engaging peer institutions in Vietnam; (ii) the policy supports needed for organizational changes at system, university, and department levels; and (iii) our evolution of the development of a model framework for widespread implementation in Vietnam and initial results which suggest that the model framework has the potential for accelerating the efforts, improve the efficiency and increasing the likelihood of success for universities that are participating in the adoption of CDIO.

KEYWORDS

Vietnam CDIO, First Year, Implementation Model Framework, VNU-HCM

I. INTRODUCTION

Along with the development of economy and society, Vietnam is facing a challenge of training a skilled labor force. This requires improving the education system, especially higher education, to meet society needs. As one of the flagship universities in Vietnam, the Vietnam National University-Ho Chi Minh City (VNU-HCM) System has spearheaded many initiatives aiming to improve the quality of higher education in Vietnam. A key effort in these initiatives is VNU-HCM's leadership in adopting and adapting CDIO principles to build a model framework to help accelerate national efforts in curriculum reform through widespread implementation of CDIO in Vietnam.

VNU-HCM started the preparation for the implementation of CDIO in 2008 [1]. Along with the leadership from the highest level, requisite supports expanding have accomplished during the preparation, since January 2010, VNU-HCM officially pilot implementation of CDIO at two departments of member universities: Department of Information Technology, University of Science and Department of Mechanical Engineering, University of Technology [2]. The pilot implementation has two main goals [1]: (i) adapt CDIO principles to systematically reform the

curriculum of our strategic university departments and to provide students with the knowledge, skills, and attitudes desired by relevant stakeholders; (ii) use the pilot implementation of CDIO at our strategic university departments as a means to develop generalized solutions that can be exported and replicated at universities within VNU-HCM System and at other universities throughout Vietnam. In this paper, we present the first year experience of implementing CDIO at VNU-HCM from the point of view of a system of universities and the achievements that we have accomplished.

II. LESSONS LEARNED AND THE CHALLENGES IN PROMOTING CULTURAL CHANGES

In 2010, our strategic departments began and have succeeded in applying the CDIO Syllabus and Standards as a guidelines for curriculum design and development in order to build the learning outcome and curricula for the Information Technology and Manufacturing Engineering Programs [3, 4]. What we have done is only the very first achievement but it results from a process of cultural and organizational change to improve the curriculum, teaching and learning methods and to provide the students with knowledge, skills and attitude meeting the stakeholders' demands.

The results are obtained due to the considerable contribution of many relevant parts of VNU-HCM, especially the great efforts of the managing board at the system level in applying and developing the solutions for change process management based on successful factors of CDIO [5] in order to create the impacts which promote the implementation of CDIO at VNU-HCM and in Vietnam.

1. Creating the motivations for moving off assumptions so as to implement CDIO

Before implementing CDIO, the design of a new curriculum or development of an existing curriculum in almost all universities of Vietnam are often conducted by key faculty members and there is almost never any participation or ideas from the alumni or other stakeholders. The interaction between this key group and other faculty members in departments is very limited. The faculty members are not provided with any official instruction for curriculum design and development in order to provide students with knowledge, skills and attitude to meet the needs of stakeholders. We have determined that creating the motivations for moving off assumptions plays an important role to implement CDIO.

In the preparatory stage for CDIO implementation, most of the relevant participants at our member universities were aware of the necessity and importance of CDIO; however, there were no official commitment from the member universities at that time. In that context, leaders of VNU-HCM have applied the rights of making decisions on education reforms to assign two departments and decide to support them in planning the project and funding for the initial implementation [1]. However, in the stage of implementation, we still have difficulties in helping all of the faculty members move off assumptions and try applying new things, such as CDIO Initiative. Our solutions to overcome these difficulties are having direct impacts on relevant participants in CDIO implementation: (i) through academic activities, we frequently arouse and confirm the important roles, great responsibilities of managers, leaders and mainly the faculty members in providing a qualified curriculum—no one but them can perform these roles; (ii) we have invited international CDIO experts to consult with faculty members and staff about experiences in improving the curriculum; (iii) we asked the member universities to send the faculty members to attend the annual regional CDIO conferences with the partial funding from VNU-HCM in order to have stronger impact on their awareness. This method is confirmed to be the most effective way to persuade the faculty members.

2. Promoting “Envolment and Ownership”

The involvement and ownership of CDIO of most members at universities and departments are still limited. We have promoted this involvement and ownership by assigning them the rights and responsibilities for using the budget from VNU-HCM; directing to establish CDIO Implementation teams at university level including the Vice-Rector (Academic), head of the academic affairs office, head of the quality assurance office, the department dean/vice dean (Academic) and several core faculty members who directly implement CDIO at subject levels. We have successfully defended the CDIO Project of VNU-HCM to the relevant ministries and got the approval for a separate budget from the government to implement CDIO (at system level and universities level). In addition, we have been continuously seeking more funding for the implementation for 7 years of the Project.

At the system level, we have expanded the involvement and ownership of relevant parts in order to fully support the implementation. Not only the Academic Affairs Department but also other functional administrative departments at VNU-HCM are responsible for the implementation of CDIO. This is confirmed by our President by assigning the two Vice Presidents and other relevant functional administrative departments to involve in the implementation. For instance, the Planning and Finance Department has actively instructed the Academic Affairs Department and the pilot departments to complete the annual financial planning for CDIO work as well as has balanced the financial resources to support more for the implementation in addition to the government budget for the Project. The Department of External Relations has successfully registered the membership of Worldwide CDIO Initiative and effectively coordinated the international cooperation to implement CDIO. In 2012, we hope to involve the Quality Assurance Center in support the evaluation of the CDIO programs.

We have also invited international experts to be involved in CDIO implementation at VNU-HCM. In addition to the participation of Dr. Ho Tan Nhut- California State University, Northridge, U.S.A, from 2008; in 2010, VNU-HCM has invited Dr. Peter J. Gray, Director of Academic Assessment - Faculty Enhancement Center, United States Naval Academy to take part in evaluating the curriculum design and development under CDIO model framework at 2 pilot departments. The participation of international experts helps us have more external human resources; on the other hand, the participation of experts with high experience of Vietnam higher education and CDIO implementation has a great impact on persuading and attracting the participation of faculty members. We will try to draw much more attention from international experts.

3. Sharing and disseminating our work within our university system and engaging peer institutions in Vietnam

To help accelerate the nation's curriculum effort and facilitate widespread implementation of CDIO, we have been broadly disseminating the implementation materials and results. We have translated the CDIO book into Vietnamese and gave it for free to universities attending the workshops that MOET organized throughout the country to promote CDIO in January 2010 [1]. This book has been reprinted in November 2010.

We host a CDIO website that makes available in Vietnamese the CDIO Syllabus, Standards, lessons learned and solutions to common implementation problems. This website is also used to support CDIO activities at VNU-HCM and disseminate the materials developed by the implementation of our model framework. Because CDIO has been implemented at two departments at two different universities within the VNU-HCM system, the CDIO website will help to manage data and information, to share materials and resources. Through the website forums, our members can discuss and share and coordinate activities to reduce cost. This website is an open and accessible channel for VNU-HCM to promote CDIO activities with

collaborators all over the world and to enable us to learn and share ideas, results and achievements and get feedback on our work.

Annually, we have hosted and participated in national and international conferences, workshops to share and learn the CDIO implementation experience. In May 2010, we invited CDIO expert to train our faculty in building learning outcome and integrated curriculum applying to the pilot departments of VNU-HCM. We also took part in the 6th CDIO International Conference in Canada in June 2010. In the conference, VNU-HCM successfully defended the application and was officially approved to become the 56th member of the Worldwide CDIO Initiative. We also presented a report on “Development of a Model Framework for CDIO Implementation in Vietnam” receiving good comments for the CDIO implementation approach at VNU-HCM. We also met international CDIO experts and had their consultants in CDIO implementation in Vietnam. The membership of Worldwide CDIO Initiative supports VNU-HCM to establish the relations with other members of the Initiative as well as to take advantage of experience and materials supplied by CDIO Initiative.

To share experience in designing learning outcomes and integrated curriculum based on CDIO approach in the first year of implementation, VNU-HCM organized the workshop on “Designing learning outcomes and integrated curriculum” on 13-14/12/2010 with the participation of many Vietnam universities, several regional universities such as Tsinghua University (China), Singapore Polytechnic (Singapore), Taylor’s University (Malaysia) as well as experts from Worldwide CDIO Initiative: Dr. Ho Tan Nhut from California State University, Northridge and Dr. Peter Gray from United States Naval Academy. This workshop is also an opportunity to evaluate the implement of CDIO model in VNU-HCM during a year and to share experiences with domestic and international colleagues. In the workshop, the participants presented their experience in the process of applying CDIO approach in building the learning outcomes and curriculum. In addition, the delegates discussed the potential cooperation among domestic and regional universities in CDIO implementation. The workshop promote the awareness on CDIO model as an approach to improve the curriculum, teaching and learning methods, work spaces as well as the quality of higher education graduates.

III. THE POLICY SUPPORTS NEEDED FOR ORGANIZATIONAL CHANGES AT SYSTEM, UNIVERSITY, AND DEPARTMENT LEVELS

VNU-HCM understands the resources are important factors in maintaining the stability of CDIO implementation at the pilot departments. Therefore, VNU-HCM has developed policies and sought the financial resources for CDIO implementation. We had the following methods to find funding from various resources: (i) We submit proposal for supplemental funding from the government budget: this resource is not large because the CDIO Project has not been included in the list of national key programs. We have made great effort for this task, which resulted in a supplemental funding from the government in 2011 for the project; (ii) VNU-HCM encouraged the financial contribution from member universities of the pilot departments: In 2010, the University of Science added new fund to build several new courses for D-I skills (Design-Implementation) for the Information Technology Programs; (iii) A regulation concerning finance of CDIO implementation was issued as a sustainable solution for the fiscal year 2010 and the planning of the fiscal year 2011. VNU-HCM gives financial support to CDIO activities at VNU-HCM level and member universities level. At department level, funding are used to pay faculty members for their time and efforts in involving in research, survey, program benchmark, training and teaching.

Until the fiscal year 2011, we have raised funds from various resources and member universities have added necessary funds for the key activities in CDIO implementation. University of Technology has spent considerable funds to build new workspace for practicing D-I skills in

Manufacturing Engineering Programs. University of Science has allocated the plan for the practice rooms of C-D-I-O skills in Information Technology Programs.

To ensure the initiative and responsibility spirit in using effectively funding resources, VNU-HCM has required the departments to have the implementation planning and to defend the budget planning. VNU-HCM also holds the annual formative and summative evaluation of CDIO implementation at department level.

One of the difficulties in implementing CDIO is the working time of faculty members, especially the key people of the implementation. In addition to be involved in CDIO implementation, they still have to ensure their teaching and research in their major. The departments and we (VNU-HCM) had quite many discussions about this matter and the solutions now are: (i) The working load involved in CDIO Project is considered the same as one in teaching; their research paper, articles about their CDIO implementation are considered the same as those in specialized fields; (ii) In addition to the key force, namely CDIO implementation Team, the departments have build many specialized groups with wider participation, also including academic staff from other departments. These groups have been operating simultaneously to support one another. This initiative is rooted the Department of Information Technology - University of Science and have undertook since early 2010. The Department of Mechanical Engineering has also applied this operation; (iii) The establishment of a center of excellence for CDIO implementation is a long-term solution. This center will provide sample procedures, models for teaching under the CDIO framework as well as training course for faculty members. This is supposed to solve the current problem of faculty members' working overload.

At the time being, we have a Center for Educational Excellent (CEE) at University of Science that provides faculty members and students with effective teaching and learning methods. With its participation in CDIO implementation, we have taken advantage of the experiences from the Center in training teaching methods for faculty members. In the initial phase, we have also invited experts from the Worldwide CDIO Initiative to support the faculty training.

IV. OUR EVOLUTION OF THE DEVELOPMENT OF A MODEL FRAMEWORK FOR WIDESPREAD IMPLEMENTATION IN VIETNAM AND INITIAL RESULTS

1. Evolution of the development of a model framework for widespread implementation in Vietnam

The implementation of CDIO not only have raised the academics staff's awareness of designing and developing of curriculum but also have promoted the innovation in teaching and learning methods.

To meet increasing demand for quality training, the implementation of this model is considered one of the most effective method to standardize the curriculum design and development. The lessons of VNU-HCM in developing curriculum under the new approach are scientific evidence and practical experience for other training institutions in the country. After the initial preparing and implementing years, the original model has been continuously customized and developed. One of the most important factors is to create the consensus of the stakeholders in the process of implementing CDIO.

The solution to a sustainable consensus in the extension of CDIO implementation is to institutionalize the implementation. In fact, the consensus among the leaders of VNU-HCM is available. Most faculty members were ready for the implementation as they recognize faculty members are the very first beneficiary of this education reform activities. However, the faculty members still need the department leaders' official commitment which leads to a proposal to the university leaders for specific policy and support in CDIO implementation. The solution is to

utilize the high consensus to institutionalize the extension of CDIO implementation into the mid-term development planning of VNU-HCM from 2011 to 2015.

Another way to increase consensus in solving problems during the implementation and use of resources is to create an alliance of departments that have common fields in implementation. Currently, the alliance includes the Department of Mechanical Engineering - University of Technology and the Department of Information Technology - University of Science. The CDIO pilot programs help improve the curriculum of the two departments and also play a key role to extend to the other departments. The collaboration between the two departments enables the mutual support and resources sharing. In the process of simultaneously implementing CDIO, the two departments found different solutions to common problems, conducted difference approaches and then compared the results. Each year, VNU-HCM intends to have several departments involved in CDIO implementation alliance; that new departments can take advantage of the results obtained from the previous departments. The experience sharing and mutual support will promote the implementation of CDIO at VNU-HCM, reduce cost and increase the success possibility.

In addition, in the process of implementing CDIO, we draw participation from not only faculty members and students but also industries and alumni. To developed countries, the participation of the enterprises and alumni in the process of improving the curriculum is mandatory. However, this trend is new in Vietnam. Therefore, attracting the enterprises and alumni to participate in the process of developing the curriculum at some pilot departments is an innovation. It requires us to focus specially on monitoring and developing these relationships. In order to accomplish this, we usually invite enterprise leaders to the information sessions about CDIO implementation and what are being done. Initially, these enterprises were not acquainted but they gradually understood their roles in university's training process. When designing learning outcomes and curriculum, we always collect feedback from the enterprises. It helps making the curriculum stay updated and meet the requirements of the enterprises. Leaders of the enterprise which have employed many graduates from the department are invited to the council of the department. In that way, these enterprises accompany us during the whole training process. When the enterprises also are the co-owner of the training process, they will be more responsible for training the students to serve their specific enterprises. We also can receive donations from the enterprises to help solving the financial problem.

To the alumni, we use a variety of electronic communication methods to convey information and collect feedback. The feedback of the alumni who are currently working will help us identify the mistakes in the training process. Annually, we hold alumni meeting to update their current work. We have contact persons for each generation. Many alumni who become key leader in these enterprises contributes more and more to our training process.

Hence, the roles of the enterprises and alumni, in addition to the faculty member and students, are extremely important in the process of curriculum designing and developing. Many departments have not paid much attention to these stakeholders before. However, after this experience, other departments is strengthening the relationship with the enterprises and building the data of the alumni. It will be very useful for the initial phase of CDIO implementation and curriculum improvement at the other departments.

Last year, the two pilot departments implemented initial steps in developing learning outcomes and designing curriculum under the CDIO model framework. All the experiences and results of the two departments have been reported to faculty members of other departments in VNU-HCM. Since then, some departments has been aware of the importance of improvement the curriculum to meet the requirements of the enterprises. Although funds have not been granted, these departments have already begun to study CDIO approach to their own departments. This shows

that the implementation at the two pilot departments has positive impact on the other departments in VNU-HCM.

Furthermore, last year we held an international workshop with the participation of many domestic and foreign universities. After the workshops, participating Vietnam universities realized that CDIO could be a reasonable solution to improve the curriculum. They would to receive assistance from VNU-HCM in implementing CDIO model framework. We did support them in planning the implementation plan and also hold introduction and training courses about CDIO for other universities. Currently, there are about ten universities that are planning CDIO implementation. This shows the CDIO model, that we are implementing provide a methodology and solutions that can assist the Vietnam universities in the comprehensive education reform.

This year, we plan to establish a club of all universities that implement CDIO in Vietnam to exchange and share experience. A reference book on CDIO learning outcomes design and curriculum development at VNU-HCM is being editing in order to disseminate information within the club members in the future.

2. Initial Results

In 2010, our pilot departments have successfully designed learning outcomes and programs for the Information Technology and Manufacturing Engineering Programs under CDIO model – an absolutely new approach. The departments adjusted CDIO syllabus to each programs, conducted surveys and group discussions, studied the material, organized workshops to learn about enterprises' demands and how the current curriculum can meet the needs. After that, they modified the curriculum. The process is implemented for the two faculties as following:

Designing learning outcomes and integrated curriculum at the Department of Information Technology

The CDIO implementation team built new learning outcomes based on the existing learning outcomes, curriculum framework, and the CDIO Syllabus. This new learning outcomes is of the 3rd level of details. Learning outcome are adjusted to the Information Technology field. The department decided to split and merge skill groups in order to monitor more clearly. In particular, group 1 still includes basic skills and fundamental knowledge. Professional and development skills are in group 2. Group 3 is a list of rubrics which relate to environment, enterprise, society and personal responsibilities. Group 4 includes teamwork, foreign language skills and personal characteristics. Group 5 and 6 were extracted from section 4 of CDIO Syllabus: conceiving, analyzing, designing and implementing skills are introduced in group 5; verification, validation, operation, maintenance and evaluation skills are introduced in group 6. The new way of group division is more suitable for the Department's curriculum. By this way, besides the skills are gathered, building an IT product is separated from its verification, and operation.

After developing the learning outcomes of the 3rd level of details, the Department conducted a survey with stakeholders in order to evaluate the training as well as stakeholders' expectation. Survey was conducted with 86 lectures, 697 alumni, and more than 30 enterprises.

The results of the survey were analyzed for building learning outcomes of the 4th level of details. Based on that learning outcomes, the Department have built an integrated curriculum. In comparison with old programs, the CDIO programs have several changes: 4 new subjects are added, some existing subjects are adjusted to meet the expected student proficiency. The detailed results of designing learning outcomes and integrated curriculum of Department is analyzed in the other report.

Designing learning outcomes and integrated curriculum at the Department of Mechanical Engineering

The CDIO Implementation teams have discussed and evaluated of the level of detail of the CDIO Syllabus. 97 criteria at the third level of detail was considered quite detailed and therefore was used to conduct surveys. The survey was conducted on 53 faculty members, 124 last year students, 50 alumni and more than 40 representatives from the enterprises.

After determining the expected learning outcomes, the department benchmarked the training program in accordance with ITU and conduct survey on subject input - output through the "Black box". 65 subjects of the Manufacturing Engineering training program was in the survey to the faculty members and the head of the subject. According to the results benchmarked with learning outcomes, the current training programs ensured most of the knowledge, skills; however, it did not meet the expected learning outcomes. Thanks to the "Black box", the department has reset the sequence of subjects. Basically, the new training program was designed from the current subjects, but the programs was restructured to ensure connectivity and support to one another. The personal skills, communication, creation of products, processes and systems are tightly integrated into the curriculum.

V. CONCLUSION

To innovate compressively the curricula, VNU-HCM has developed and implemented a model framework based on the adoption and adaptation of CDIO approach, an Initiative for engineering education reform being adapted by many universities. Not only the initial results improve basically content of the programs, teaching and learning methods, and learning environment for the pilot programs, but also they have successfully convinced the faculty members and staff change from the un-professional working way to an scientific, systematic one as CDIO approach.

Through the implementation of CDIO, we have more practical basis for strengthening and improving the policy for education reform: human resource are the most important one to enable change - innovation in education. Thus, the education reform can succeed only when there are reasonable policy to create motivations toward cultural and organizational change in education system. The lessons learned from VNU-HCM's CDIO implementation are useful scientific basis and practice for other universities across the country. The CDIO implementation pilot model of VNU-HCM will be continuously improved so as can be widely disseminated within VNU-HCM system and to other universities.

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