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Worldwide CDIO Initiative: Implementation Experience in Singapore

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This article is dedicated to analysis of CDIO standards implementation in Singapore Polytechnic curricula. This paper presents evidence of compliance of Singapore Polytechnic curricula with CDIO standards. It is considered that experience of CDIO implementation in Singapore Polytechnic is successful.

Key words: CDIO, Singapore Polytechnic, competence-based approach.

SIntroduction

Singapore Polytechnic was established in 1954 to prepare specialist in different fields – engineering, information technologies, building, business, finance, law etc. The aim was to ensure technological and economic development of the country [1, p. 1]. Singapore has been successfully developing over past 50 years and it has changed its status of the Third World country for that of the most developed one. Being one of the few national institutions, Singapore Polytechnic played a significant part in this process.

From 2004 Singapore Polytechnic began to implement new initiatives and approaches to improve the quality of education and to make their graduates competitive within modern economic environment. In pursuit of new teaching methods and technologies, systemic and interdisciplinary approaches to knowledge acquisition, integrated curriculum, and practice based education, Singapore Polytechnic joined Worldwide CDIO Initiative. The aim of the present article is to describe the experience of CDIO implementation into Singapore Polytechnic educational programs and to prove correspondence of the programs to 12 CDIO Standards [2].

Standard 1. CDIO as the context for engineering education.

To implement CDIO Initiative Singapore Polytechnic began to enhance educational programs giving particular emphasis on development of creativity, innovative and business thinking. Moreover, the educational process was organized as a system for students to pass all the stages of innovative process – from idea (concept) to implementation. The correspondence of Singapore Polytechnic educational programs to Standard 1 is proved by a number of factors. Firstly, there is cultural context, within which education, practice and knowledge acquisition are ensured [4, p. 29, 41, 43]. Secondly, there is a plan of educational programs enhancement [1, p. 2]. Moreover, the idea of program enhancement is shared and actively supported by the Board of Governors of Singapore Polytechnic[1], while scientific publications and presentation on CDIO topic [1, 3, 4] demonstrate the high level of teachers' involvement.

[1] http://www.sp.edu.sg/wps/portal/vp-spws/!ut/p/c1/04_SB8K8xLLM9MSSzPy8xBz9CP0os_hQD1NXIzdTEwOLMEs3A09_xwB_F7cwRxNjA_2CbEdFABoCxrw!/?WCM_GLOBAL_CONTEXT=

Standard 2. CDIO learning outcomes.

Singapore Polytechnic is the place where customized learning outcomes were designed on the basis of those of CDIO [6]. The outcomes are detailed in the document that implies interdisciplinary knowledge and integration of required skills, personal values, and ethical priorities. Apart from fundamental knowledge and skills, the student should acquire additional competences, such as problem solving, leadership, teamwork, communication, professional ethics [1, p. 2]. The list of competences is validated with key program stakeholders. In particular, learning outcomes of educational program программы «Electrical and Electronic Engineering» were set [1, p. 10-11]. They include technical disciplinary knowledge, individual and communicative skills, as well as CDIO competences. The validity of documents, which describe set of learning outcomes in detail [1, p. 10-11; 4, p. 16, p. 23, 25] and define the knowledge and personal skills of the graduates, confirms effective implementation of Standard 2.

Standard 3. Integrated curriculum.

Standard 3 implementation in Singapore Polytechnic caused the enhancements of educational program structure [4, p. 27]. Singapore Polytechnic diploma program comprises three years: the first year is exposure of expected CDIO learning outcomes, the second year is development of CDIO skills, and the third year is practice and application of acquired CDIO skills. CDIO learning outcomes customized for Singapore Polytechnic [6] are those of discipline «Introduction to Engineering» [4, p. 41], which serves as a basis for discipline «Design Build Course» [4, p. 42] and the project on social innovations during the second year. Design Build Course as well as the project on social innovations allow students to work on the final project during the third year [4, p. 39]. However, not all the programs of Singapore Polytechnic include integrated curriculum, therefore, the level of conformity with Standard 3 might be assessed as satisfactory.

Standard 4. Introduction to Engineering.

At Singapore Polytechnic, discipline «Introduction to Engineering» is a component of integrated curriculum [4, p. 41]. It provides a framework for the practice of engineering and ensures product, process, and system building experiences as well as acquisition of personal and interpersonal skills. For example, the final task of «Introduction to Engineering» is to conceive, design and construct a springal. This corresponds to top ranks of implementation scale.

Standard 5. Design-Implement Experience.

Singapore Polytechnic pays particular attention to Standard 5 implementation. Standard 5 was first implemented into educational program «Electrical and Electronic Engineering», which caused changes in all curricula of Singapore Polytechnic: students should develop a project at the end of every academic year [1, p. 4]. During the first year students should study module «IDEA» (Innovation, Design and Enterprise in Action), the aim of which is to provide basic information on key aspects of innovative process. As a result, students assess the demand, make business plans and design prototypes [1, p. 4].

During the second year students should develop a group project based on knowledge acquired in preceding engineering courses. Project scopes are defined in accordance with the specialties: 1. Aerospace engineering. 2. Microcontrollers. 3. Biomedicine. The project aim is to provide students with the opportunity to put their ideas into life and apply their engineering skills within an involving project [1, p. 6]. Expected learning outcomes are detailed in educational programs of Singapore Polytechnic [1, p. 10-11].

During the third year students should implement an interdisciplinary project based on knowledge acquired in several

preceding engineering courses. In other words, students from different institutions join to make a team for the project implementation. Project scope is broad enough – it might be bread vending machine or dehydrated milk distribution system.

In general, the level of Standard 5 implementation is high.

Standard 6. Engineering Workspaces.

Workspaces and laboratories which encourage hand-on learning of product, process, and system building skills deserve the high grade in Singapore in general and Singapore Polytechnic in particular[2]. This also refers to the workspaces that support disciplinary knowledge acquisition as well as social learning [1, p. 6; 4, p. 29, p. 42, p. 51, p. 57, p. 59, p. 61, p. 62].

Standard 7. Integrated Learning Experiences.

The integration level of expected CDIO learning outcomes and acquired skills is very high (refer to Standard 3). Moreover, according to educational programs, education is provided with due consideration of world experience and involves teaching by experienced industrial professionals [1, p. 2]. The level of Standard 7 implementation is high.

Standard 8. Active Learning.

Active learning is provided within design-implementation experiences [1]. However, these methods are not woven through the whole curriculum and the level of conformity with Standard 8 might be assessed as satisfactory.

Standards 9 and 10. Enhancement of Faculty CDIO-competence and Faculty Teaching Competence.

The level of Standards 9 and 10 implementation is quite high in Singapore Polytechnic. A lot of teachers participate in events, which upgrade their professional competence in active learning, learning assessment, and development of integrated curriculum. It is important to notice that teaching competence in educating and assessment are regularly tested and enhanced. Education specialists in Singapore are generally estimated to be the best in the world[3].

Standard 11. Learning Assessment.

Assessment of student learning in personal and interpersonal skills, and product, process, and system building skills, as well as in disciplinary knowledge is appropriate. Methods of assessment match to expected learning outcomes. Different methods are used to assess customized outcomes throughout the whole period of studying.

Standard 12. Program Evaluation.

In Singapore Polytechnic there is a system that evaluates programs against the twelve standards, and provides feedback to students, faculty, and other stakeholders for the purposes of continuous improvement [1, p. 8; 4, p. 47; 5, p. 8].

Conclusion

The experience of CDIO implementation in Singapore Polytechnic is undoubtedly successful and can serve as an example for Russian engineering institutions. Particular attention should be paid to the efficient use of facilities and rich design-implement experience revealed in hand-on projects.

[2] http://www.sp.edu.sg/wps/portal/vp-spws/spws.org.abtsp.vstsp.fac?utm_source=spws&utm_medium=facilities_banner&utm_campaign=spwsbanner

[3] http://www.topuniversities.com/university-rankings/university-subject-rankings/2013/education-and-training#sorting=rank+region=+country=+faculty=+stars=false+search=

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