A STUDY ON CDIO-BASED STEAM PROGRAM DESIGN AND IMPLEMENTATION

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ABSTRACT

STEAM (Science, Technology, Engineering, Art, and Mathematics) education has gained popularity in schools, colleges, universities across the United States, Europe, parts of Asia, recently raised in Vietnam. Despite its attraction and preparation for the 21st-century skills, little empirical research and good implementation exists to guide the STEAM program design process as well as effective instructional practices, and even less is known about the challenges associated with individual assessment aiming to expected learning outcomes of the modules developed in the STEAM program. This paper will present a study on the design process and implementation of a CDIO-based STEAM program. In which, the CDIO framework, standards and syllabus are embedded and aligned with the STEAM program in two aspects: in most of the stages of the continuous improvement process of program development and implementation, and in lesson syllabus structure. The research concludes with implications for educational researchers and educators to consider that it is very potential to apply CDIO principles for an integrated curriculum with a project-based method for STEAM education, especially with the CDIO-based STEAM syllabus. The initial satisfaction survey which was taken on more than a hundred students has been carried out and obtained a high score of satisfaction, revealing the suitability in both curriculum and teaching-learning activity design. The CDIO-based maker space reflects its superior advantages of supporting innovative learning environments. Therefore, good practices on CDIO implementation are recommended for further discussion by the STEAM community.

KEYWORDS

STEAM Education, STEAM Curriculum Design and Implementation, Maker Space, CDIO Standards 1, 2, 3, 5, 6, 7, 8, 9, 10, 11

INTRODUCTION

STEAM Education

According to the National Science Teaching Association, "STEM education is an interdisciplinary approach to learning where rigorous academic concepts are coupled with real-world lessons as students apply science, technology, engineering, and mathematics in contexts that make connections between school, community, work, and the global enterprise enabling the development of STEM literacy and with it the ability to compete in the new economy" (Tsupros, 2009). The term of "Arts" is adding to STEM to bring the art factor to the topic, in the way student design and implement and the output impact of their products. This may help to nurture student's innovative ability and empathy, creating balance and connection between STEM subjects and Art.

STEAM education, especially in the Industrial Revolution 4.0, focuses more on the application of knowledge, by that STEAM knowledge has been conveyed into active teaching and learning activities such as project, digital fabrication or additive manufacturing, etc. Instead of learning each subject separately, STEAM education trends to bring them together for an interdisciplinary, multi-skill educational approach based on practical application. Learner's competences on problem-solving and soft skills are developed through experiential and active learning activities. Therefore, in each topic of STEAM, students mostly face with a specific real challenge and need to search, discover, utilize equipment, tools, technology and apply their related knowledge in STEAM to solve the problem. These inspire students with making and innovation and by then enhance them with personal and interpersonal skills in consideration of outcome impacts such as application, environment, community, society, etc. Generally, STEAM education promote creative learning - a factor that stimulates students' passion for learning (Leshner, 2018).

CDIO-Based Relevant STEAM Approaches

While the CDIO framework is designed for post-secondary engineering programs, it has been successfully used at the high school level and even junior high level to teach topics in STEM fields. As studied in (Hladik, 2017), there are barriers including a lack of teacher knowledge and confidence in the subject, and in Canada, a lack of a nationally-defined curriculum. Computational thinking is often taught outside of the formal educational system, and in some cases, alongside engineering design concepts. The breakdown of each of the C-D-I-O steps in section 4 of the CDIO Syllabus 2.0 is analyzed and compared against programming and computational thinking frameworks and design processes. The proposed technique provides a framework for teachers to create their computational thinking activities which facilitate elementary students to move through the CDIO steps as they complete such activities.

STEM-based learning in the educational process of CDIO-based undergraduate programs has been implemented and reported in (Gafurova, 2017). Proposed gamification model is applied through the first year of Introduction to Engineering course as a stage of students' acquaintance with the problems of the engineering profession. The game utilizes the CDIO approach by recreating the mechanisms of engineering companies' functioning at high-technology market. The experience of implementation of STEM-based learning in undergraduate programs, organized through networking collaboration between Siberian Federal University and STEM-Games LLC was shared by Arnautov (2018). STEM-based learning activities are shaped into two modules representing a team-based engineering design competition with an emphasis on different aspects of engineering. The modules utilize the principles of CDIO bringing up a project-based approach and active learning as primary educational techniques.

Though integration of engineering into middle school science and mathematics classrooms plays an important role in developing engineering aspect to early students, successful pedagogies for teachers to use engineering talk in their classrooms has not been fully understood. A study by Johnston (2019) addresses “How a middle school life science teacher use engineering talk during an engineering design-based STEM integration unit”. The CDIO principle was exploited behind the story: The teacher used to talk to integrate engineering in a variety of ways, skillfully weaving engineering throughout the unit. Engineering concepts with science and mathematics content of the unit are integrated and modelled the practices of informed designers to help students learn engineering in the context of their science classroom. In another research by Cedere (2019), teaching/learning approaches for the Millennium generation are studied to find out the meaningful ways to this generation. This issue is especially important in STEM education. The obtained results showed that students-millennials as regards the learning of STEM subjects can be described as real-life oriented, digitally educated who want to participate actively in the teaching/learning process and who want to receive the feedback. This certainly show greatly potential application of CDIO standards 5, 7 and 8 in making STEM education effectively to the Millennium generation.

Challenges in STEAM Program Design and Implementation

As STEAM education has been approving obvious advantages and has been applying widely, many challenges have been existing in design and application of STEAM education at any levels, even at modern and developed educational systems such as the United States and other countries over the world, and so in Vietnam. Some of the key challenges of STEAM program design and implementation as named as follows:

- Lack of supporting policy and guidance on STEAM education implementation, from learning outcomes formulation, curriculum design to implementation and quality assurance, lack of standard syllabus and framework for STEAM lessons, etc;
- Which learning and teaching methods are suitable and effectively applied, how to connect and integrate into the school curriculum to not overload students with new knowledge and skills, how to evaluate learners as well as STEAM program at their outcomes, etc;
- Inadequate interest of administrators on STEAM education; not relevant competencies of the management staff and STEAM teachers;
- Lack of infrastructure of schools, making space for students to make and innovate.

Proposed CDIO-Based STEAM Program

Considering challenges in STEAM program design and implementation, we propose in this study our STEAM Program, named GoFab (Go for Fabulous Leaning), developing the power within children through innovative co-making and English learning. GoFab is operated as a public-private partnership educational model to drive innovation, between The University of Danang, Arizona State University (USA) and Fablab/Maker Innovation Space Danang. The program curriculum has been based on the needs of stakeholders (community, partners, parents, K-12 children) to set its program learning outcomes. An outcome-based STEAM program development model has been proposed by LYD Edu according to CDIO framework as demonstrated in Figure 1. The continuous improvement process of the STEAM program development and implementation follows 4 phases: Conceive - Design - Implement - Operate, in which, most stages of the process are designed aligning to CDIO standards. In lesson level, the syllabus structure for STEAM subjects is developed well-matching with the CDIO Syllabus. The knowledge is conveyed to students through a series of teaching and learning activities which, in meanwhile, also helps develop students' personal, interpersonal and creating skills.

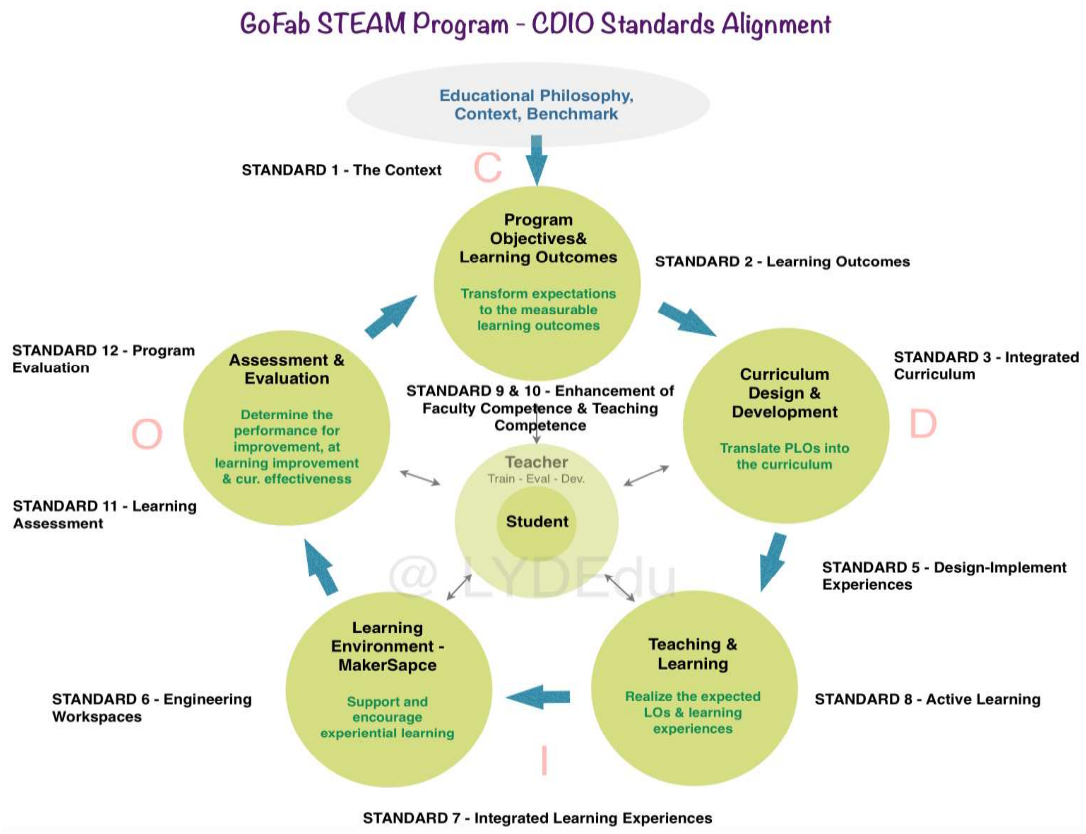

Figure 1. The outcome-based STEAM program development model *(designed by LYDEdu)*

CDIO-BASED STEAM PROGRAM DESIGN AND IMPLEMENTATION

The Context

Approaching to CDIO Standard 1 "The Context", the continuous improvement process of GoFab STEAM Program is designed in a lifecycle development and deployment according to 4 major CDIO-based phases:

- Conceive of the context: Demands from stakeholders (community, partners, parents, students) in STEAM education, STEAM standards, the available competences of students and the financial capacity/furniture of the institutions as well as benchmarking to other STEAM organizations have been considered.
- Design the program: Expected program learning outcomes (PLOs) and then the integrated STEAM curriculum have been designed to translate the program objectives and PLOs into the curriculum, including lessons, designed teaching-learning-assessment activities to make its learning outcomes attainable and realistic.
- Implement: Designed teaching, learning and assessment activities have been conducted at every STEAM class; faculties have been trained for STEAM teaching competences;

Maker Innovation Space has been developed to directly support a space and tools for hands-on activities designed in the integrated curriculum.

- Operate: Performance of students have been assessed and feedbacks from stakeholders have been collected have been assessing for the program continuous improvement.

Expected Learning Outcomes

Program expected learning outcomes have been designed focusing on developing competencies (including knowledge, personal and interpersonal skills, and attitudes) for students to be confident in communication, be able to work in a team, be able to apply their studied knowledge and skills as well as new knowledge to solve real-life problems in STEAM fields, and be able to make a prototype following design thinking process. Based on the outcomes and feedback from stakeholders on the program, the learning outcomes could be reviewed for continuous improvement.

Curriculum Design and Development, and Teaching Learning Activities

Based on the proposed learning outcomes and regarding CDIO Standards 3,5,7 and 8, GoFab STEAM integrated curriculum has been developed applying project-based learning method to provide students with active learning, design-implement experiences.

Among a variety of educational methods, project-based learning (PBL) is considered to be the key method for integrated curriculum and generally for STEAM education. PBL brings students chances to expose their active learning ability which is essential for their study in an integrated or international learning environment later on and prepare them life skills. A key factor for effective STEAM education is a teaching-learning method in which students can learn to innovate, think critically and independently and self-discovery. For example, the topic of robot design in which students have a chance to design, assemble, program and control a robot can cover both 5 subjects of science, technology, engineering, arts and maths. Moreover, these practical activities will help students remember knowledge longer and deeper. Students will work in groups, discuss and explore by themselves, apply knowledge into practical activities and then be able to transfer knowledge to others. With this way of learning, teachers are no longer the ones who impart knowledge but will be the guides for students to build their knowledge.

Project-based lesson plans for specific STEAM topics have then developed following 5E's model and design thinking process, and well-aligned with CDIO syllabus as demonstrated in Table 1.

Table 1. Mapping GoFab lesson plan teaching-learning activities to CDIO model.

Period	CDIO-based activities	STEM activities	Duration
1	C	Warm-up	0-5 mins
	C	Engage-Explore-Explain	15-45 mins
	C	Elaborate	0-20 mins
2	D	Image-Design-Plan	0-20 mins
	I	Create-Test	30-45 mins

	I	Competition/Game at the end of the lesson	0-20 mins
	O	Homework: Evaluate-Improve	Carried out at home

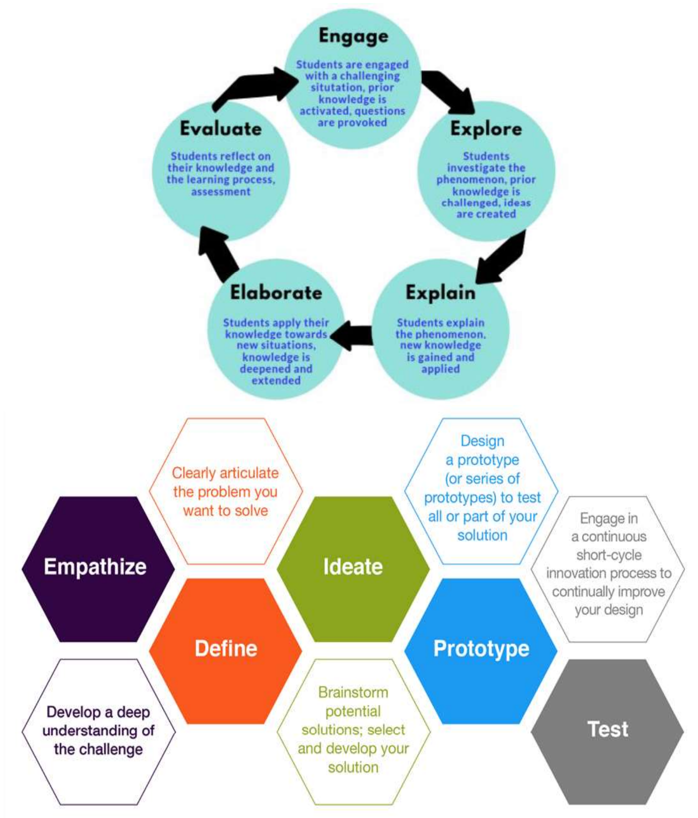

Figure 2. The 5E's learning cycle model (Bybee, et al., 2006) and Design thinking process diagram.

The 5E's (Engage - Explore - Explain - Elaborate - Evaluate) model (Bybee, et al., 2006) and Design Thinking process (Lee C., et al., 2018) are showed in Figure 2. The 5E's model is popular in teaching science because it follows the natural way that people apply to explore and gain new knowledge in their lives. Besides, the design thinking process is also applied in solving problems and creating new products for the future. The combination of 5E's model and design thinking process could be integrated into a proper approach to conduct a STEM lesson by adding 2 extra phases called Imagine-Design-Plan and Create-Test in the following structure: 1. Engage - Explore - Explain; 2. Elaborate; 3. Imagine - Design - Plan; 4. Create - Test; 5. Evaluate.

Structure of a GoFab lesson plan for a 90-minute lesson includes these teaching and learning activities. Particularly, students firstly face with a challenge (the main problem to solve) related to a specific topic of STEAM. Students are driven to Engage to the problem through related videos or attractive situations. They will then be asked to search and Explore by themself to understand the theory or principle behind. In the next steps, they are asked to Explain to others through several questions or games, and then will Image, Plan and Design their own solution/product based on what they understand in available resources of materials in the team. These phases are necessary for a lesson with creating activity. In the phase of Create-Test, they will have a good opportunity to work with the tool, to make mistakes and to deal with the real problems. After finishing their product or finding their solution, students will present their solution to others, and then improve if needed based on comments from their peers and instructors, with or without using English. This step could be repeated until they are satisfied with the final solution/ product/ prototype. Figure 3 demonstrates learning activities using the integrated 5E's model and design thinking process at a GoFab STEAM lesson.

Such GoFab lesson plan follows project-based approach and Conceive-Design-Implement-Operate model allows students to place themselves as an innovator, recall and reinforce their knowledge, explore and discover different possible solutions, develop critical thinking, build-up their skills of problem-solving, communication, teamwork, practice, English language, and follow the design process. Each lesson activities and outcomes will contribute to the achievement of designed program learning outcomes.

Figure 3. Learning teaching activities at a GoFab STEAM lesson at Fablab/Maker Innovation Space Danang.

Learning Space for Innovation and STEAM Practice

Along with teaching and learning methods, workspace - mentioned in CDIO standard 6 - equipped with tools and equipment that supports students in making and innovation is one of the important factors of STEAM education. Different models of fablab or maker space has been applied over the world to help students and the community for self-fabricate activities. Such making space would be very helpful for STEAM learning and teaching activities.

Fablab/Maker Innovation Space Danang was founded for the purpose at the University of Danang, is a fabrication innovation network model developed worldwide, born at Massachusetts Institute of Technology (MIT), to provide tools and mentorship for collaborated innovation, to serve children, students, faculties and startups. It provides equipment, software, space for co-making (and mentorship at needed) to help students design and fabricate prototypes. Fablab/ Maker Space model, at the higher level, is also helpful for designers, artists, businessmen and others; assisting makers in innovative experiments in a collaboration way, serving those working in STEAM and extended to business and social studies, etc. Figure 4 shows the model of Fablab/Maker Innovation Space to support students in learning, making and innovating.

Figure 4. STEAM education at Fablab/Maker Innovation Space Dananang.

Faculty Competences Training

Faculty competence improvement as required in CDIO Standards 9 and 10 is the most key factor for the success of a STEAM program. Even though at new educational methods as project-based, problem-based, or experiential learning, the faculty does not anymore take the role of a teacher but plays more on the role of a facilitator who drive the activities in STEAM class. However, to inspire students with a passion for innovation, there is a need of passionate STEAM teachers who has enough ability to help students to reinforce their knowledge and develop their personal and interpersonal skills through projects, problem-solving, in teamwork activities or at maker spaces, etc. Many organizations have put their effort to train STEM teachers. In November 2009, the US government's "Educate to Innovate" program invested US$ 700 million with the desire to train 100,000 STEM teachers. Beside STEAM curriculum development, Fablab/Maker Innovation Space Danang has developed the Train-The-Trainer program to help enhance faculty competence covering knowledge, skills and attitude through training modules and experiential learning activities such as:

- introduction to steam, teaching strategies, lesson planning and assessment
- steam roadmaps and project-based units of inquiry
- design process, maker spaces, and game-based learning in steam
- reflecting and improving, maximizing student engagement and blended resources.

Student Assessment

Student assessment has been conducted in GoFab STEAM program through different forms of formative and summative assessments, such as Q&A, prototype accomplishment for knowledge learning outcomes assessment; student performance in group discussion and working, idea presentation for skill learning outcome assessment by teachers or their peers; and observation by teachers or peer ratings for attitude learning outcomes assessment.

As GoFab STEAM program focuses on project-based learning where students need to apply their knowledge and both personal and interpersonal skills (such as teamwork, leadership, communication, information searching, making, time handling, even economic consideration,..) to be able to solve the problems or complete the project, assessment on final results/products of the individuals or groups has been used as one of the most effective and suitable methods of student assessment.

OUTPUTS AND REFLECTION FROM STAKEHOLDERS

Over the last 4 years, we have initiated, designed, implemented, and operated, kept revising to introduce this pilot STEAM education program to students and society in Vietnam. The GoFab program has been delivered to 4,000 kids and more than 7 schools and received positive feedback from learners who have experienced this program on a variety of topics in STEAM and satisfy their passion in innovation and making things and producing prototyped solutions, of which about 400 are often like studying foreign languages.

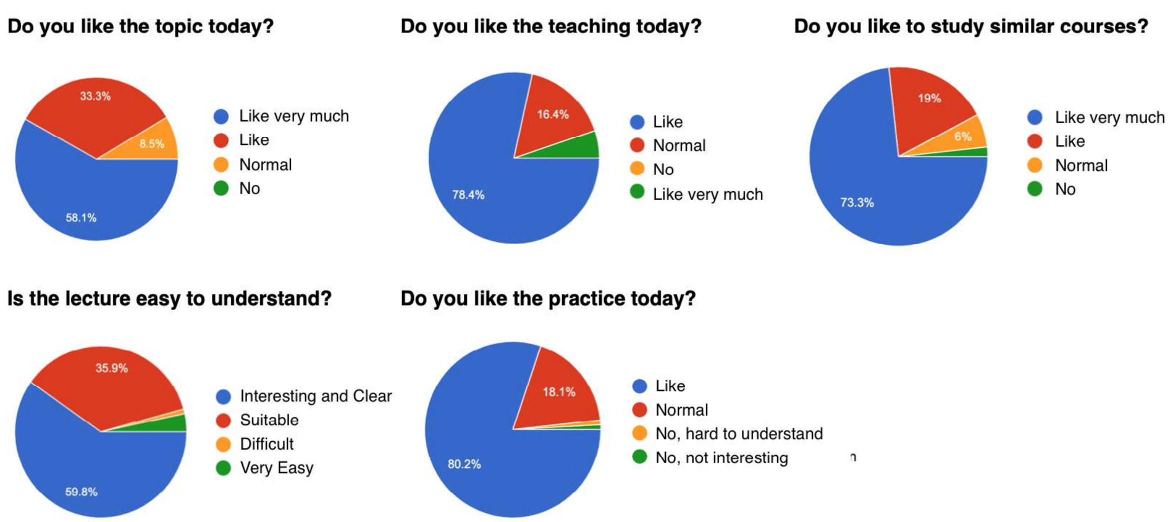

Figure 5. Survey results of 117 students turns joining GoFab STEAM program, taken in 2018.

A survey on satisfaction of 117 primary students, from Skyline International School - Danang, Vietnam joining 10 different STEAM topics and being taught by 7 different STEAM teachers on GoFab STEAM program on 2018 were taken and indicated in the Figure 5. The topics were about: Make a Flipbook, Create a Snow Flake using 3D printing, Build a Study Table with Newspaper, Design a Stamper, Build Your Nametag, Make a fabric pencil case,...which were designed to be appropriate to the age.

More than 90% of 117 responses showed their very positive feedback on the *Curriculum Topics, Lesson Content and Structure* ("Do you like the topic today? Is the lecture easy to understand?) and 92% like to continue the program (Do you like to study similar courses?"). This means the topic and the lessons were suitably designed for the learners. On the other hands, more than 80% of feedbacks showed their interests in the *Teaching and Learning methods and activities* ("Do you like the teaching today? Do you like the practice today?"), which were carefully designed for the integrated curriculum. In that, each lesson was project-based design with initial guidance on theory and following hands-on activities for creating things. With this teaching-learning method, students were provided opportunities to reinforce their knowledge and develop their personal and interpersonal skills. The students had to complete their project at the end of each lesson and through that, student's performance were assessed. Therefore, this positive result also reveals an initial success in developing learner skills since the students were mostly satisfied with their learning process and the results they achieved. The assessment on students and program has been in progress but such initial result approved the effectiveness of CDIO principles applied on the program.

SUMMARY OF EXPERIENCES AND CHALLENGES

Recommendations and Sharing

STEAM education is an integrated teaching method with an interdisciplinary approach and through practice and practical applications. STEAM education reduces the gap between academia and reality, creating a workforce with "instant" work capacity in a highly creative working environment of the 21st century, whose main skill set includes critical thinking and problem-solving skills, communication and collaboration skills, creativity and innovation skills, leadership and social influence skills, technology, information and media literacy skills, etc. It is believed that STEAM education will bring fundamental benefits in preparing a new workforce for the 21st century. This is consistent with the trend of new integrated education.

The CDIO standards 1, 2, 3, 5, 6, 7, 8, 9, 10, 11 have been well reflected in the whole GoFab program and showed a significant impact on its success. The program outcomes, curriculum, syllabus, teaching and learning activities, facility support through maker space, train-the-trainer have been implemented and revised for continuous improvement following CDIO framework based on feedback from stakeholders.

CDIO-based STEAM program will bring to the educators many benefits and a systematic administration, from curriculum design, teaching-learning methods, faculty training, maker space development and maintenance. Despite all these benefits, efforts and all the potential for development, change is slow and far from certain. Changing institutions and their associated cultures is not an easy task as there are many interconnected units in the institution. For smaller-scale change, we only need to consider a subset of these issues. However, for large-scale institutional, it is so important to change everything relevantly; every piece must be addressed, and all the above elements of the STEAM program model needs to fit together.

Since different types of customers have different demands on the program, listening to the needs will make the program development more realistic and successful. Integrated curriculum design, guided with CDIO syllabus, is the best choice for new education, especially STEAM education, where students are the centre and able to develop their competence including knowledge, skills and attitude.

We are now with well-meaning faculties that are largely unaware of the dramatic advances that have been made in the past few decades in understanding the learning of STEM and best practices for teaching. It is necessary to build design-implement lessons embedding active-learning methods and creating additional opportunities for integrated-learning experiences within the STEAM program.

Although the benefits of maker spaces for STEAM education are obviously, the management for effective usage and maintenance should be considered. A business model for the operation of a maker space for sustainable development has still been discussed. Many models of maker space have been introduced, such as a fablab/maker space belonging to a school/university like a free lab for student, or one belonging to a school/university charging on use, or such a one operating independently to a school/university, applying membership fee for anyone using, etc. Each has its pros and cons.

CONCLUSIONS

STEAM education highly promote the formation and development of problem-solving capacity for students. This educational objective means that students should engage, explore, study the knowledge of related subjects to the problem through different sources (books, online sources, etc.) and utilize maker spaces for tools, equipment to solve the problem. The design-implement experiences, integrated learning experiences and active learning standards are recognized as perfect matching tools to reach the objective. This knowledge and skills must be integrated and complementary to each other to help students not only understand the principle but also be able to practice and create their products in life. Therefore, the CDIO syllabus and integrated curriculum standards are the key factors to the successfully integrated STEAM program.

To have any hope of spreading changes in STEAM education at all levels, from elementary school to university, we must take into account all the units within institutions that are relevant to the change being made. The renovation should start from changing multiple faculties, departments and how the institution operates, down to modifying individual courses and curriculum, upgrading infrastructures which enable innovating and co-making abilities of students, and last but not least, the faculty development needed to support such efforts. The context and working space standard, thus, must be applied for the effective Conceiving--Designing--Implementing--Operating of the STEAM program.

REFERENCES

Alan Leshner and Layne Scherer (Editors). (2018). Graduate STEM Education for the 21st Century, *The National Academies Press*. Retrieved from https://www.nap.edu/catalog/25038/graduate-stem education-for-the-21st-century

Arnautov, A., Gafurova, N., Fadeev, Y., Dyomin, V. (2018). Building STEM education framework through networking collaboration. *Proceedings of the 14th International CDIO Conference*, Kanazawa Institute of Technology, Kanazawa, Japan, June 28 – July 2.

Bybee, Rodger & Taylor, Joseph & Gardner, April & Scotter, Pamela & Carlson, Janet & Westbrook, Anne & Landes, Nancy. (2006). *The BSCS 5E Instructional Model: Origins, Effectiveness, and Applications. BSCS*. Online source:https://knowledgequest.aasl.org/the-5-es-of-inquiry-based-learning/

Gafurova, N., Arnautov, A., Fedoseev, A., Fadeev, Y. (2017). Fostering Engineering Thinking with Curriculum Integrated STEM Game. *Proceedings of the 13th International CDIO Conference*, Calgary, Canada, June 18-22

Hladik, S., Behjat, L., Nygren, A. (2017). Modified CDIO Framework for Elementary Teacher Training in Computational Thinking. *Proceedings of the 13th International CDIO Conference*, Calgary, Canada, June 18-22

Johnston, Amanda & Akarsu, Murat & Moore, Tamara & Guzey, S.. (2019). Engineering as the integrator: A case study of one middle school science teacher's talk. *Journal of Engineering Education*. 108. 10.1002/jee.20286.

Lee, C., Lee, L., Kuptasthien, N. (2018). Design thinking for cdio curriculum development. *Proceedings of the 14th International CDIO Conference*, Kanazawa Institute of Technology, Kanazawa, Japan, June 28 – July 2.

BIOGRAPHICAL INFORMATION

Fablab Danang (Gofablabs) was only one of three start-ups selected to demo innovation products to President Barack Obama in 2016 in HCMC and also, selected as one of eight start-ups out of about 1,000 applicants to join the Global Entrepreneurship Summit in Silicon Valley 2016, hosted by President Obama and the United States government.

Anh Thu Thi Nguyen got her doctoral degree at The Catholic University of America, USA in 201. She is currently the Vice-dean of the Faculty of Advanced Science and Technology at DUT, UD, where CDIO-based innovation projects are actively applied. Anh Thu is also a vice-director of the Danang International Institute of Technology, UD conducting studies in IoT, AI engineering solutions for smart city, health care, etc. Loving creativity and high quality of education, from 2016 she has also joined Fablab Danang (one of 600 Fablabs over the world established by MIT) as a Senior vice-president and focusing on academic leading of innovation projects in STEAM (STEM+Art) for K-12 students and community and has founded L.Y.D.I.N.C Ltd. company with LYD3D brand for 3D printing development and LYDEdu brand for consultancy in Quality Assurance on STEAM Education.

Hoi Ba Nguyen got his Engineering degree at the University of Danang-University of Science and Technology; Master degree of Asian Technology Institute, Bangkok, Thailand; was a technological engineer at Microfuzzy GmbH Munich Germany; doctoral degree at CUA University, in Washington DC, USA and Washington National Hospital. Hoi co-founded and co-operated Novas from 2005 through 2015, developing a technology company to more than a hundred employees, with the most prominent technical products & services being the four-way LHD device and automatic production system, factory-wide and model teaching products. He was also a co-founder and advanced university program manager for 2005-2009, in partnership with Washington University, Seattle. Currently, Hoi is the interim Dean of School of International Education, University of Danang, in collaboration with Arizona State University to develop and operate GoFabLabs / Makerspaces for the community: Gofab initiative to serve students' creativity through digital manipulation, GoGoHab Apparel low-cost rehabilitation services for patients, and VPICS / Projection for students developing new products that serve the community.

Tram Kha Ngoc Nguyen graduated Master’s degree from the University of Danang - University of Education with Methodologies of Physics major. She is passionate about education with 5 years of work experience, teaching 7-15-year-old students and developing lesson plans. Being the Innovation Curriculum Lead of GOFAB and STEM teacher at Fablab/Maker Innovation Space Danang gives her the ability to work under pressure with dedication, responsibility and to bridge the gap between theory and practice in building STEM curriculums.

Tuan Van Pham had been designated to Vice-Chair of Electronic and Telecommunication Engineering Faculty, DUT in 2010-2014; Deputy Director, Center of Excellence, DUT in 2011 - 2018. He has been appointed to Director of Educational Testing & Quality Assurance Department, DUT since 2014. Tuan has been certified as Vietnam Educational Quality Assessor since 2016 and then AUN-QA Assessor since 2017. Tuan was DUT Project Manager of HEEAP Program (Higher Engineering Education Alliance) in 2010 – 2018, VULII Program (Vocational and University Leadership and Innovation Institute) in 2012 – 2016, BUILD-IT Program (Building University-Industry Learning and Development through Innovation and Technology) in 2016 – 2020; UD-DUT Project Leader for CDIO framework project at UD-DUT in 2016-2019.

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