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STUDENT-LED ENGINEERING INNOVATION AND ENTREPRENEURSHIP EDUCATION MODEL IN CAN THO UNIVERSITY

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Abstract. The paper presents a student-led model for developing creative thinking to create high-quality human resources in the industrial revolution. This model is developed based on an open space with full of modern equipment for learning and scientific research activities of Can Tho University students. This open space is called the Maker Innovation Space and is run by most students. Students participating in projects such as Undergraduate Research Initiative (URI), engineering project in community services (EPICS), or Maker to Entrepreneur Program (MEP), scientific research projects, course projects or graduation theses can freely use this space. In addition, the Maker Innovation Space also organizes many STEM/STEAM training courses for both students and high school teachers to deploy scientific research programs to high schools. The Maker Innovation Space of Can Tho University works very effectively and is considered as a creative thinking model to create high-quality human resources for the economic and social development of the Mekong Delta region.

1. INTRODUCTION

According to statistics from the General Statistics Office and the Communist Party of Vietnam Online Newspaper published on 11/11/2019, the agricultural industry in the Mekong Delta has grown by more than 3% per year (2016-2018). (while the average growth rate of the whole country is only 2.67%/year), contributing 34.6% of GDP of the whole country's agricultural sector and 33.5% of the Mekong Delta. In 2018, the Mekong Delta continued leading the country in rice, shrimp, pangasius and fruit production with export turnover reaching 8.34 billion US dollars. The production structure is actively shifting towards the market, more adaptive to climate change,

ensuring quality and competitiveness. Exports of the Mekong Delta account for over 80% of the country's rice export turnover, of which 95% is pangasius, 60% is shrimp and about 65% is fruit [1].

However, the majority of labor resources in the Mekong Delta are manual workers. According to the 2013 survey data of the General Statistics Office, the labor force of the Mekong Delta region is 10,322,900 people, accounting for 19.4% of the national labor force (ranked second after the Red River Delta). In which, the labor force is 77.2%, the lowest among 6 economic regions. The rate of trained workers is only 10.4%, the lowest in the country. For comparison, with a population similar to that of the Mekong Delta, the proportion of trained workers in 2013 in the North Central and Central Coast regions is 16.4% [2].

According to the master plan on socio-economic development and key economic zones in the Mekong Delta by 2020, with a vision to 2030, the proportion of trained laborers will reach over 55% by 2015 and over 70% by 2020, creating annual jobs for 15 - 15.5 thousand employees in the period 2011 - 2015 and 17 - 17.5 thousand employees in the period 2016 - 2020 [3]. Moreover, Resolution No. 120/NQ-CP dated November 17, 2017 on focusing on implementing more breakthrough solutions to bring the Mekong Delta to a prosperous and sustainable development emphasizes that the formation of high quality human resources for the Mekong Delta is the key solution [4].

The industrial revolution 4.0 (Industry 4.0) has had a global impact, requiring the Mekong Delta region to apply effectively. In particular, the Prime Minister of Vietnam gave instructions on the sustainable development of the Mekong Delta at a conference on March 13, 2021 in Can Tho. Thereby, the Prime Minister also emphasized that education is the key to sustainable development in the Mekong Delta: basic education, vocational education, high-quality education and actively attracting talents to contribute brains, wisdom for the development of the Mekong Delta [5]. However, there is a shortage of high-quality labor resources in the Mekong Delta.

At the World Economic Forum 2020, the top 10 skills that will play an important role in the new century are identified as follows: Analytical thinking and innovation; Active learning and learning strategies; Complex problem-solving; Critical thinking and analysis; Creativity, originality and initiative; Leadership and social influence; Technology use, monitoring and control; Technology design and programming; Resilience, stress tolerance and flexibility; Reasoning, problem-solving and ideation

[6]. Therefore, to integrate and compete in the region and global context, the Mekong Delta needs to focus on developing skills for a high-quality workforce, especially creative thinking.

This study presents a model of developing creative thinking for students of Can Tho University through the construction and operation of the Maker Innovation Space (MIS) and the organization of EPICS, URI, and MEP extracurricular classes.

2. CREATIVE THINKING DEVELOPMENT MODEL

2.1. MIS construction and operation

Creative thinking is a component of everyone's success. Therefore, in the university environment, it is necessary to have an open space with full tools or modern equipment to support the creativity and innovation of students. In recent years, many universities have paid attention to students' leadership, entrepreneurship, and creativity. Specifically, many universities in Vietnam have established start-up consulting centers for students such as: Center for Technology Business Incubation of Nong Lam University [7]; Center of Innovation and Start-up of Ho Chi Minh City University of Technology and Education [8]; Technology Business Incubation Center of Ho Chi Minh City University of Technology [9]; Center for Students Consultancy, Assistancy and Start-up of Can Tho University [10], Maker Innovation Space of Can Tho University (MIS-CTU) [11]. Maker Innovation Space is a new factor in the past few years in Vietnam. Up to now, there are three MIS established across the country based on funding from the US Agency for International Development (USAID). The first MIS was established in the High-Tech Park of Ho Chi Minh City. The second MIS is located at Danang University of Technology. And the third MIS was built at Can Tho University. Most of the operational purposes of these MISs are not different, but the operating model of each place has its own specific characteristics.

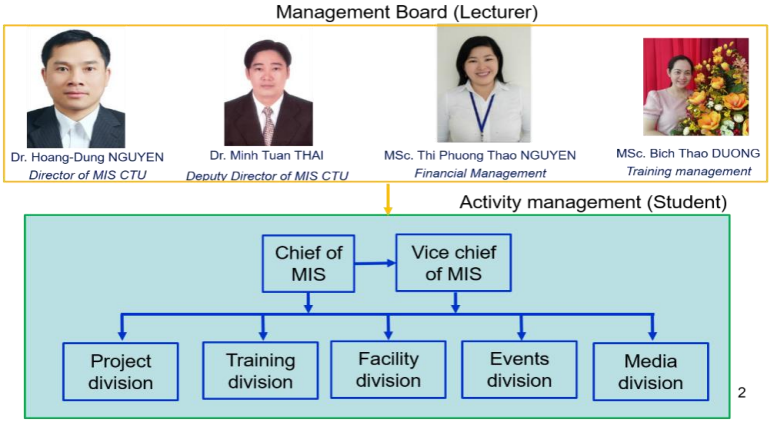


Figure 1. Operational model of MIS-CTU

MIS of Can Tho University was established on April 5, 2019. Four faculty members were appointed as part-timers to manage the MIS. It is an autonomous department under the supervision of the university. In order to operate effectively, the Management Board has decentralized maximum for students to operate. The operating model of the MIS is shown in Figure 1. With this operating model, lecturers only play the role of supervision and direction, while students are the active people in all activities. This has maximized students' creative thinking: planning, implementing plans, evaluating results, drawing experiences and developing orientations. Some outstanding activities of MIS have been carried out such as training a number of modules in the curriculum such as EPICS, project-based learning, graduation project; implementing scientific research programs such as URI; start-up training for students in the MEP; STEM/STEAM training for both high school teachers and students. In particular, MIS is the place to receive many foreign delegations to visit. This is an opportunity for students to develop their English communication skills. Through these activities, students' skills have been further enhanced. Figure 2 presents the survey results on the satisfaction of students participating in activities at MIS-CTU.

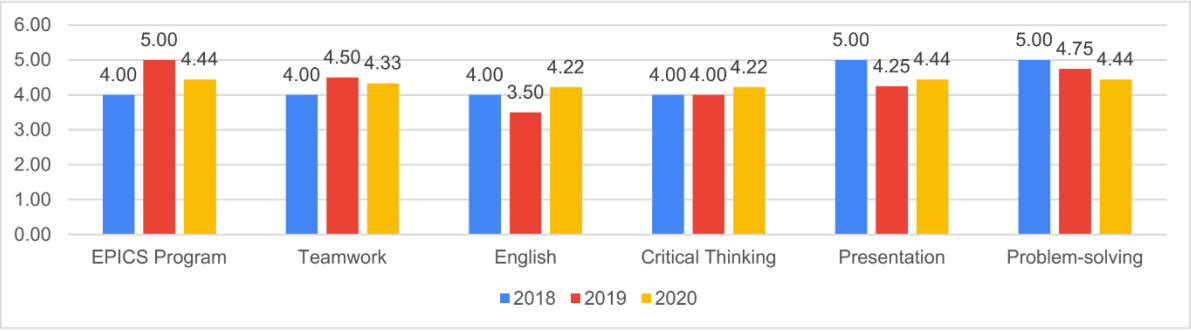
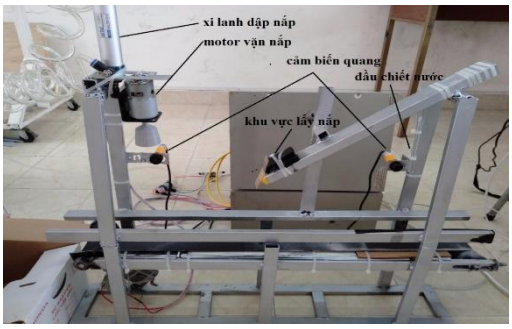


Figure 2. Survey results on student satisfaction after participating in activities at MIS-CTU (Level 1 lowest and highest level 5)

Figure 3 presents the results of students' scientific research activities before the MIS was established. Most of the models are in rudimentary form and do not have high aesthetic appeal. Students are not brave enough to participate in competitions outside of university. And Figure 4 depicts students' creative activities in learning and scientific research based on the MIS model. Product models are created with the participation of many different disciplines leading to better scientific research and highly aesthetic products. In particular, students have participated in many competitions outside the school and achieved high results.

Robotic arm to support physical therapy



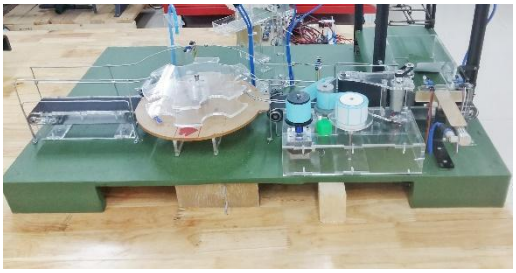
Automatic filling and capping system

Aeroponic vegetable growing system

Solar panel control system

Circulating shrimp farming model Concrete mixing model

Figure 3. Some typical results in students' scientific research before the MIS established



Automatic filling, labeling and capping system

Robotic arm to support physical therapy

Science and technology innovation contest

Science and technology innovation contest

Student research showcase

Control robot arm with brain waves

Competitions outside the university

Competitions outside the university

Figure 4. Some typical students' scientific research activities based on the MIS model

2.2. Building and implementing extracurricular programs

MIS has relatively effectively implemented extracurricular training activities such as STEM/STEAM programs for high school students and teachers. Since it was founded, MIS has received and trained an average of 100 students each year. Figure 5 shows the number of students participating in STEM/STEAM classes at MIS from 2019 to 2021. Figure 6 shows the activities of these programs. These extracurricular programs provide content related to creativity and innovation activities to help learners solve real-life problems based on the application of science and technology. Students are encouraged to participate as teaching assistants to help each small group work effectively to achieve training goals.

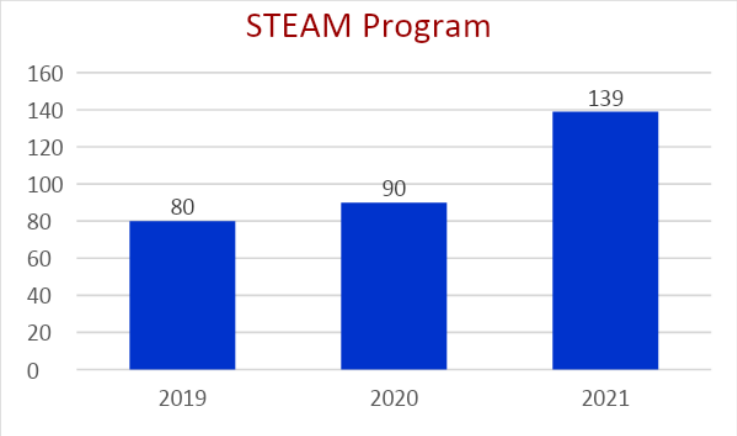


Figure 5. Statistics number of students participating in STEM/STEAM programs at MIS

Products of middle school students in a STEM program

Middle school students participating in a STEM program

Middle school students in a STEM program

High school students in a STEAM program

Figure 6. Middle and high school students participating in the STEM/STEAM programs

Figure 8 presents a number of Can Tho university students participating the activities at MIS-CTU, their post graduation job, and their projects from 2018 to 2021. There were 2603 students participated MIS-CTU's from April 2019 to December 31st, 2019. In 2020 and 2021, it was decreased 810 and 412, respectively because of the nCoV-19 pendamic. For the post graduation job of students has increased 94% in 2018, 95% in 2019, and 100% in 2020. In addition, the students projects have strongly moved up from 66 (before using MIS-CTU) and more than 130 (after using MIS-CTU). The first six-month of the year 2021, 38 projects reported in June 2021 while many students have been registering to do theses and will defense by December 2021.

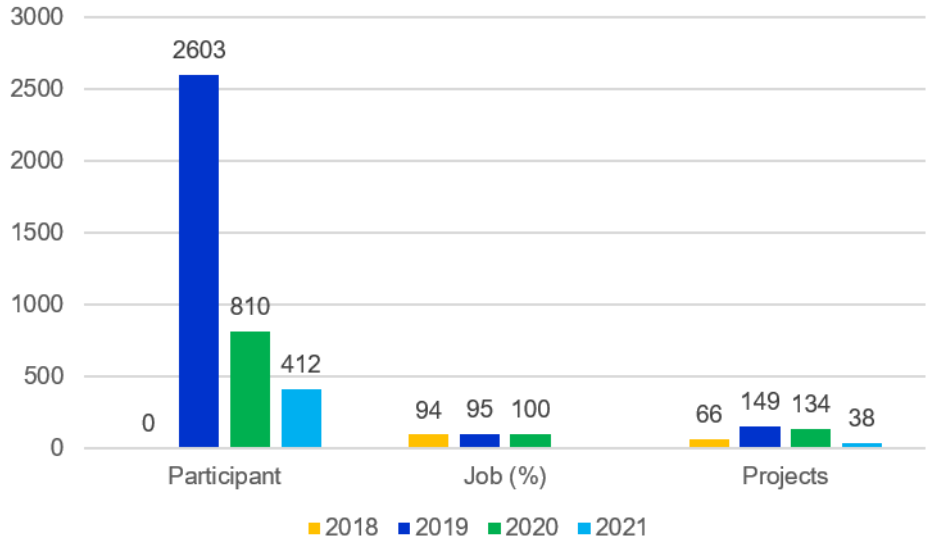


Figure 7. So sánh tác động của KGSC đến các hoạt động của sinh viên

In the coming time, MIS will continue to maintain training courses on STEM/STEAM. Furthermore, community projects (EPICS), university student pilot research (URI) and entrepreneurship programs (MEP) continue to be maintained. At the same time, training activities according to the orders of enterprises or high schools related to the field of Science and Technology will be expanded. Especially, extracurricular classes such as "One Day as a Mechatronics Engineer" or "One Day as an Information Technology Engineer" are designed to help students experience and think more creatively.

3. RESULTS AND DISCUSSION

Can Tho University students have just joined EPICS, URI, and MEP programs in the last 2 years. The number of students participating is depicted in Figure 8. For the university student pilot study program (URI) there is no limit on the number of students in the group and no limit on gender and discipline. Students choose topics to research by themself. Each study group will be guided by a mentor. Students will report regularly to the mentor and the coordinator in English. The output of the project can be in the form of a prototype. This project helps students to learn from each other because in the group of multidisciplinary students, critical thinking, creativity as well as English skills are also developed (Figure 2).

Community project (EPICS) attracts many students of Can Tho University to participate. This is a project to help students develop comprehensive skills. In the project, students will work in groups. Each group must include students from many

different disciplines and must include at least one female student. In this project, groups will interview to find out the needs of the community. The group will then discuss and propose solutions to solve the selected problem. Especially for this project, students must develop real products. The groups will use tools and measuring equipment at MIS to build their products. This is also a project that helps students develop many skills such as creativity, critical thinking, and leadership thinking in groups to make the project complete (Figure 2). Figure 9 shows the activities of Can Tho University students participating in a EPICS program: presenting their projects in English to the jury, receiving certificates after participating in the program.

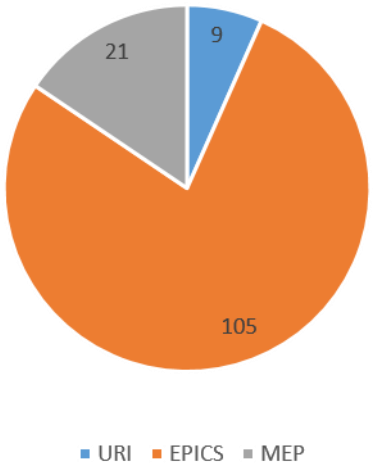
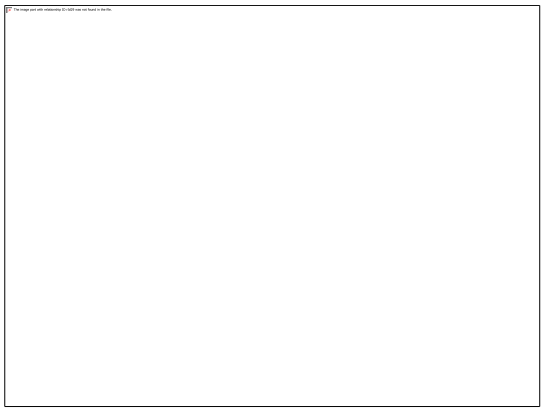


Figure 8. Number of students participating in URI, EPICS, MEP programs

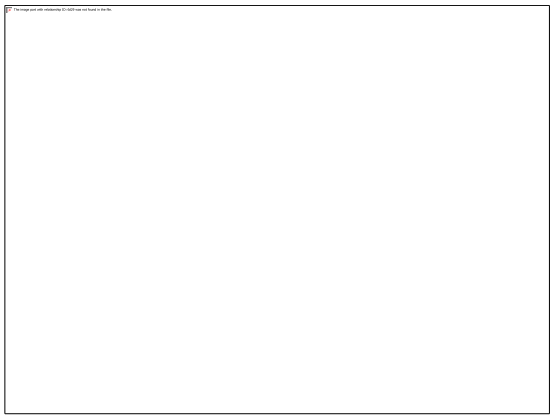
After completing EPICS projects, the teams with the best results were selected to participate in the start-up program (MEP). In the MEP program, students were equipped with knowledge and skills on entrepreneurship such as building business model canvas and developing customers. Teams developed English language evidence-based pitch decks that are built upon real data garnered from initial customers. Finally, teams joined a Venture Demo Day where they present their pitch decks in front of investors.

It can be seen that projects from URI, EPICS and MEP are a series of actions that can help students develop comprehensive skills. This is a very important luggage to help graduated students more successfully when applying for jobs as well as starting businesses. Moreover, all of these projects all require multidisciplinary students to participate. Therefore, this is an opportunity to spread these programs to students of other faculties in the university. When students graduate, they will be a

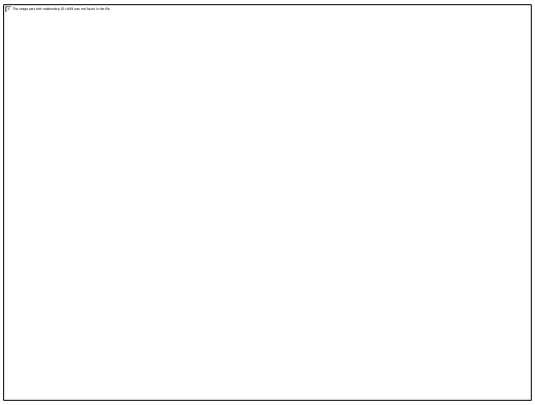
source of high-quality labor for socio-economic development in the Mekong Delta region in particular and the whole country in general.



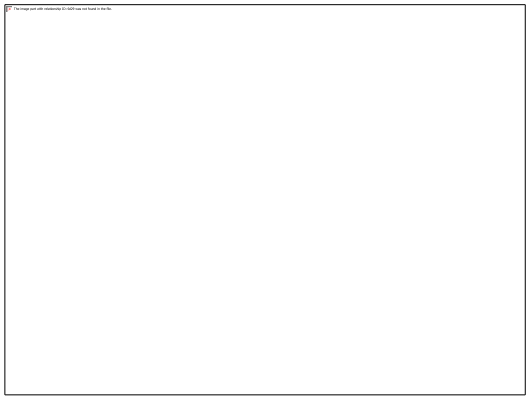
Harvesting mango model



Students in a EPICS project



Smart aquarium



Students are given certificates

Figure 9. Students participating in the EPICS projects

4. CONCLUSIONS AND RECOMMENDATIONS

The paper presents a model for developing creative thinking for a high-quality labor force in the new context. MIS is a place for students to freely create, invent and implement projects to improve their professional skills. Furthermore, STEM/STEAM programs help students from elementary to high school to early access to the scientific research environment. From there, it helps them to be active in creative thinking to solve future problems scientifically. Therefore, the model proposed in this paper should be replicated throughout the Mekong Delta from primary school to high school.

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