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EVALUATION OF ENVIRONMENTAL ENGINEERING EDUCATION PROGRAM FOR STUDENTS FROM SOUTHEAST ASIA TO HIGH SCHOOL IN JAPAN

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ABSTRACT: High schools in Gunma Prefecture, Japan, conducted an environmental engineering education program for international students from Southeast Asia for 13 years from 1998 to 2010. The purpose of this study is to understand the impact of the program on former international students and Japanese high schools as of now, 10 years after the end of the environmental engineering program. International students stayed in a Japanese home for a year and learned environmental engineering technology while interacting with Japanese high school students. In order to sort out the different types of exchange activities between former international students and Japanese high schools, and to do a post analysis, we conducted a survey of former international students and Japanese high school students, Southeast Asian and Japanese high school staff and host families. Using the survey data, a logic model for the environmental engineering education program was created. As a result, it was found that three elements of cross-cultural understanding, training agricultural engineers, and acquiring language skills are important for global human resource development. And it was found that the three elements involved four resources/inputs: homestay families, support for language learning, acquisition of agricultural technology, and learning and living experiences in foreign countries. It was found that the four resources exist all over the country, the program is likely to be applicable nationwide, and the global human resource development program can be disseminated anywhere.

Keywords: engineering education, high school, Southeast Asia, evaluation, logic model

1. INTRODUCTION

For the development of the agricultural field in Asia and the development of human resources that can play an active role as an international setting, an agricultural high school in Gunma prefecture in Japan, accepted foreign students from Southeast Asia (Philippines, Thailand, Malaysia, Indonesia, Mongolia) for 13 years from 1998 to 2010 as part of the Environmental Engineering Education Program. (Asia Agricultural High School International Student Acceptance Project) Even after the program ended, exchanges between former international students and Japanese high schools continued, and now exchange programs between Japanese agricultural high schools and the Philippines and Thailand.

2. PURPOSE OF THIS STUDY

2.1 Previous Studies

Tran Van Niuh et al. Stated that land-use change in Thailand was largely driven by economic development, education and infrastructure improvements [1]. Suzuki measured the effects of short-term study abroad programs for university students and investigated the factors[2]. Mamiya was clarified that the Japanese study abroad in Asia increased their knowledge and interest in Asian politics, economy, history, and culture, and also increased their willingness to interact with Asian people and their willingness to contribute to Asia[3].

The International Affairs Division of the General Affairs Department of Gunma Prefecture stated that in the promotion of the exchange program for international students of Asian agricultural high schools, as a result of the project there had been a positive effect not only on the international students, but also on the students and staff involved [4].

A study by Goji at Hiroshima University on the influence of the experience of studying in Japan on the intercultural adaptation of ex-students in the workplace of foreign employees suggests that the experience of studying abroad is positive for intercultural adaptation in the workplace. This effect was confirmed by Omae et al. in their study [5].

The positive influence of an experience of studying abroad had on voluntary activities and career development was also shown, and that time spent studying abroad may promote voluntary activities and contribute to career development.

Iketani's research shows the influence and significance of exchange programs with international students on Japanese people that experience of multicultural coexistence in the usual environment on campus leads to increased contact with foreigners in daily life. And that going out is not necessarily internationalization. In this way, many previous studies have shown the effects of studying abroad or accepting international students [6].

In Okuda's research trend on the effects of career education and vocational education in high school, most of the studies that examined the effect of career education in high school were biased toward focusing on the effect of "pre-high school graduation." It reveals that very few studies have analyzed the effects on “employment” [7].

In this study based on the fact that Okuda's post-project impact analysis is scarce, we investigated the career path of former international students after the project and the impact of the project. Takada showed in the current status and issues of university management plans [8] that a medium-term plan that clarifies the logical structure according to a logical model is desirable for formulating a medium-term plan for national universities.

Looking at research on Asian agriculture and Japan, Ito proposed that Japan provide Asia with technology that guarantees food safety and security in the Asian Agricultural Growth Strategy [9]. Sakurai stated the importance of grasping the needs suitable for the country and sustainable research and development in the Current Situation and Problems of Agricultural Mechanization in Southeast Asia [10].

In this study, the research method was examined with reference to the structural analysis using the logical model presented by Mr. Takada.

The purpose of this study is to clarify the effects on former international students and Japanese high schools 10 years after the end of the environmental education program.

2.2 Research Method and Target

The research method was as follows. The logic model was applied to structurally deconstruct the contents of the program, and to understand the resources utilized in each component, the activity contents, and the produced results. The logic model is a systematic diagram of the path toward the realization of the ultimate vision of a project or organization and is likened to a program blueprint.

The research target is a project to accept international students from Asia to Japan. There are 178 former international students. Since 10 years have passed since the end of the project, it was difficult to obtain quantitative information from all former foreign students, such as conducting a questionnaire with all of them. Therefore, we conducted a hearing from 33 former international students who we could contact and visit, and conducted a questionnaire and a hearing from the faculty members who were in charge of the international students at that time, constructed a logic model, analyzed and evaluated it. We also conducted a supplementary survey on mutual exchange between Asian countries and Japanese high school students, which began in 2012. The specific method is as follows.

1) Implementation of environmental engineering education program and hearing survey
2) Construction of logic model for environmental engineering education program
3) Analyze and evaluate the logic model to understand the effect of the program.

3. EDUCATION PROGRAM AND SURVEYS

3.1 Engineering Education Program

International students from Southeast Asia will homestay at the home of a Japanese family for a year and learn environmental engineering and agricultural techniques while interacting with Japanese high school students. Students came to Japan in May and for the first semester until August, they mainly studied Japanese at Gunma Prefectural Seta Agriculture and Forestry High School. During the second semester starting from September, students will be divided into eight agricultural high schools in Gunma prefecture, depending on the learning content of their international students, and they will stay in a family centered on farmers. In August, they experienced about a month of farm stay and practiced practically to learn agricultural technology.

Fig. 1 shows various agricultural training experiences such as rice planting, crops, biotechnology, livestock, and landscaping. Fig. 2 shows Japanese training in the classroom.

3.2 Hearing Survey

In order to understand the structure of the program, the staff in charge of international students at the time provided information such as the annual schedule of the program, the timetable of the international students, the event plan, and the career paths of the current international students. Interviews were conducted with former international students and the staff in charge of international students in September and December 2019 for former international students, and in February and March 2020 for former staff in charge of international students. The contents of the interview were about the merits and demerits of the program, the difficulties in implementing the

program, and current profession.

The items identified as merits in the results of the interview survey were learning languages, experience in adolescence and being exposed to agricultural and advanced technologies. Disadvantages include high prices, differences in lifestyle and religion, and dietary differences.

Among N=33, the career paths of ex-international students obtained from the interview survey show that they were more likely to work in agriculture and agriculture-related industries. And they become active as a leader in various fields.

Fig. 1 Experience of various agricultural training (taken by the international exchange teacher)

Fig. 2 Language learning and life in Japan (taken by the international exchange teacher)

The staff in charge at that time said that although it was a very difficult business, they were able to connect with each other and still have relationships with international students and host families at that time.

Also, a former international student said that the training was very meaningful and became a compass for his current life.

4. LOGIC MODEL ANALYSIS

4.1 Definition of Logic Model

The "logical structure of a certain measure" is called a logic model. A logic model clarifies the logical causal relationship that leads to the achievement of a certain measure. Formulating a logic model means conceptualizing measures, discovering design defects and problems, preparing for other program evaluations such as impact assessment, and logically planning measures before or after the fact. It is meaningful when it comes to policies and their evaluation.

4.2 Usage Example of Logic Model

The logic model is widely used in sports, education, social activities, etc. because it can verify the effects of projects and training, and the causal relationship between the results and the activity contents and business contents after setting basic goals.

In this research, we set the basic goal of international human resource development and verified the project with the necessary elements as homestay, support for language learning, acquisition of agricultural techniques, and living experience in a foreign country.

4.3 Logic Model for Program

In this study, an environmental engineering program was analyzed, and a logic model was created. Table 1 shows the flow of the manifestation of planning effects along the framework of resources, activities, outputs, and outcomes.

The purpose, inputs, activities, initial outcomes, intermediate outcomes, and final outcomes of the logic model of the environmental engineering education program are shown below. The background to the successful project was that agriculture, which was a key industry, was in danger of declining as the economic growth of Asian countries proceeded, and the aim was to rebuild agriculture in Asia. The purpose of the program was to achieve the aim of developing human resources who can be active internationally.

Table 1 shows the definition of the constituent

elements in the logic model and the cases handled in the research. The purpose of what the plan aims at is set, and the necessary elements to achieve it are resources. Table 1 shows the relationship between resources and final outcomes.

A short-term exchange program between Japan and Asian countries started in 2012, triggered by an environmental engineering education program. Compared to the one-year program, there are advantages such as the lower cost and shorter duration that makes it easier to participate in, and it can be expected to play a role as an opportunity to develop human resources who can play an active role internationally.

4.4 Analysis by Logic Model

4.4.1 Purpose

The environmental engineering education program was started with the aim of agricultural reconstruction and economic development in Asian countries. Against this background, in Asian countries, agriculture has been a key industry of the country until recently, but due to recent changes in the industrial structure due to economic growth and the decline of agriculture, the reconstruction of agriculture has become an issue. Based on this, this program aims to develop human resources who can play an active role internationally.

4.4.2 Resources (inputs)

Resources (inputs) are all management resources used for executing the plan. The number of families accepting international students was 149. In language learning, 5 Japanese teachers, 1 counselor, classmates, HR teachers, exchanges among international students, etc. were supported. All the elements and conditions that agriculture can tackle, such as nature, farmland, prefecture agricultural high school and agricultural college, agricultural testing grounds, farmers, and agricultural engineers, were taken as agricultural technology acquisition. In addition to the above, the

Table 1 Concept of Logic model and each component

Elements	Definition	Main cases
Purpose	What the plan aims for	Human resource development capable of international success
Resources	Management resources used to execute the plan	・Homestay families ・Support for language learning ・Agricultural technology acquisition ・Learning and life experience in Japan
Activity	Means for implementing the plan	・Home stay ・Lessons and life abroad ・Learning and practical training at agricultural high school ・Practice at farms and research facilities ・Support by assigning Japanese teachers ・Daily language activities
Initial outcome	Elements needed to achieve the intermediate outcome	・Home stay ・Experience living abroad ・Agricultural knowledge acquisition ・Agricultural practical skills acquisition ・Language learning support
Intermediate outcome	Elements needed for final outcome	・Intercultural understanding ・Agricultural engineer training ・Language acquisition
Final outcome	Goals of what they are trying to change	・Development of global human resources

participation of international students in school events and daily life were taken as learning and life experiences at Japanese high schools.

4.4.3 Status of activities

This study dealt with two programs. It is a one-year environmental engineering education program from Southeast Asia to a Japanese high school, and a short-term mutual exchange between high school students between Japan and the Philippines and Japan and Thailand since 2012.

Activities in the program include homestay for cross-cultural understanding and lessons/living in foreign countries, learning/practice at agricultural high schools to train agricultural engineers and practical training at farms and research facilities, and language acquisition. Support by a Japanese teacher for daily activities and daily language activities.

4.4.4 Status of initial outcome

As an interim outcome, homestay to realize cross-cultural understanding, life experience in foreign countries, acquisition of agricultural knowledge to realize cultivation of agricultural engineers, acquisition of agricultural practical ability, and language learning support for acquisition of language ability are initial outcomes.

4.4.5 Status of interim outcomes

Interim outcomes are cross-cultural understanding for global human resource development, agricultural engineer training, and language acquisition. These are the conditions for achieving the final outcome.

4.4.6 Status of final outcome

The goal of the program is to develop human resources who can be active internationally. Therefore, the final outcome was global human resource development. In the long-term program, 178 international students from Southeast Asia completed one year study abroad in Japan, and in the short-term program of mutual exchange between Japan and Asia, a total of 280 Japanese high school students and 210 Philippine and Thai high school students have finished the exchange.

5. EFFECTS OF PROGRAM

The project structure was created from the results of hearing the program, the logic model of

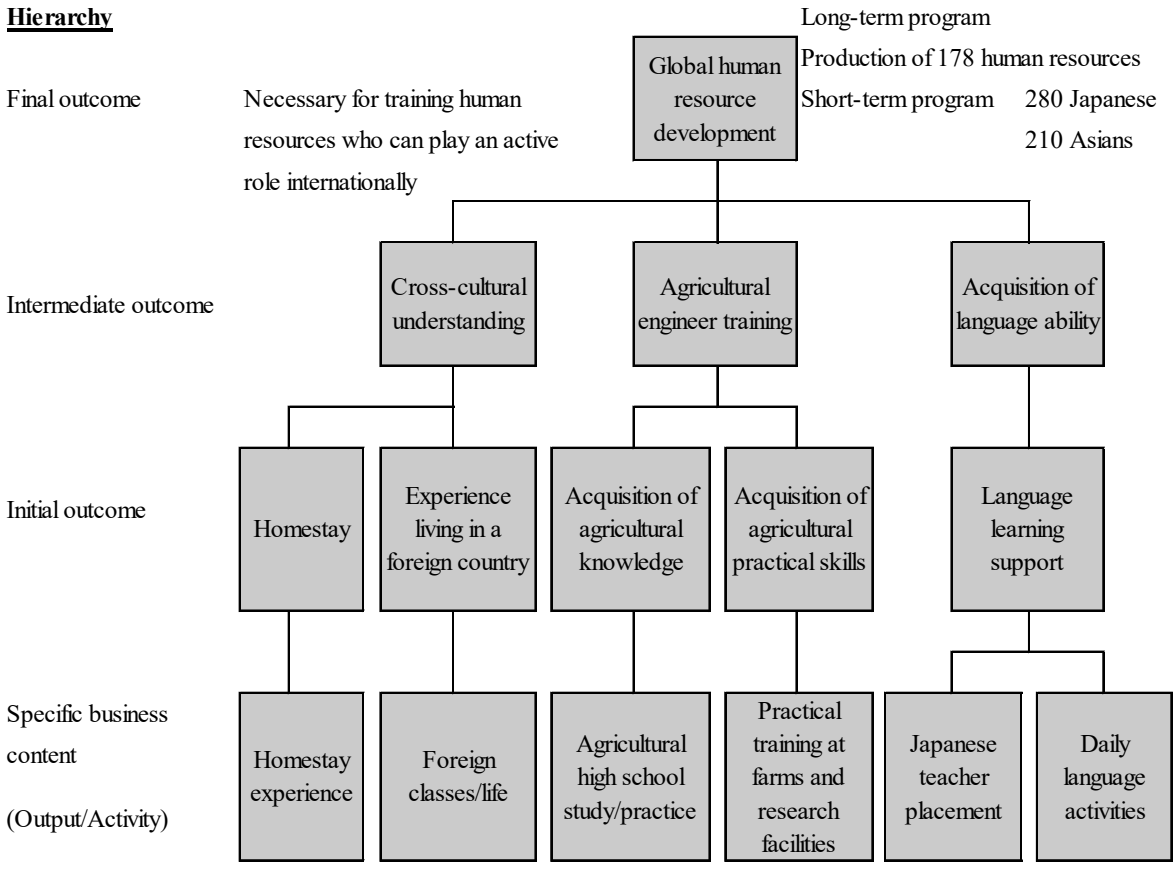

Fig. 3 Structure of the Program

the environmental engineering program, and the concept of each component (Table 1). Fig. 3 is a model of the situation in which international students from Southeast Asia got their current course after studying for one year in Japan. It was found that the flow of inputs, outputs, and outcomes has the structure shown in the figure, which leads to the achievement of the project purpose.

From Fig. 3 and Table 1, four resources (inputs), homestay, support for language learning, acquisition of agricultural technology, learning and living experience overseas are important elements of the program and are linked to outputs and outcomes.

It was found that activities that utilize the four resources have the effect of leading to an understanding of different cultures and an improvement in motivation for learning, leading to the path to agriculture and related industries, and

leading to the development of human resources who can play an active role internationally.

The resources used in this program are available to many local governments throughout Japan, and we believe that if the program spreads nationwide in the future, it will lead to further global human resource development.

6. MATCHING THE CAREER PATHS

The basic goal of this program is to develop human resources who can play an active role internationally.

The career paths of former international students are shown in table 2.

The career paths of former international students obtained from the hearing survey are as follows. The hearing survey method is a direct interview with international students and an interview with the instructor in charge. N = 33, which is a small sample, but more than half have advanced to agriculture and agriculture-related industries and are active as leaders in various fields.

If doctors and general enterprises are regarded as non-agriculture and agriculture-related industries, the career realization rate for agriculture and agriculture-related industries is 19/33 = 57.5%, which is based on the current ratio of agriculture and agriculture-related working population in Asian countries. If you look at it, it is considered to be a high number.

7. CONCLUTION

7.1 Results of This Study

The results obtained in the present study can be summarized as follows:

1) Cross-cultural understanding is important for global human resource development.

Table 2 The career paths of international students

Career destination	Number of people
Agriculture	6
Agriculture-related industry	4
Veterinarian	1
Doctor	4
Landscape contractor	1
General company	10
Agricultural teacher	3
Administrative relations	2

2) It is important to train agricultural engineers to develop global human resources.
3) Acquisition of language skills is important for global human resource development.
4) It was found that the implementation of the project is likely to lead to the appropriate course selection.
5) 1) to 4) are linked to global human resource development.

This study evaluated an environmental engineering education program for international students from Southeast Asia to Japanese high schools.

By implementing the program, we also found that there is a tendency to get a profession that makes use of specialized skills, that international exchange continues even after the project ends, which can lead to language learning opportunities and an improvement in learners' motivation.

Through an environmental engineering program that lasted 10 years, 178 global human resources have been trained and are active. It also led to a short-term mutual exchange program, with 280 Japanese high school students and 210 Asian high school students completing the program, improving cross-cultural understanding and language skills, learning agricultural technology in Asian countries, and improving motivation to learn.

From the above, it was found that there is an effect of improving the motivation of high school students, and by recognizing this effect, the cooperation of high schools and local residents can be obtained, and the effectiveness of this program could be demonstrated empirically.

7.2 Subject for Next Study

We created a logic model to show the structure and effects of the long-term study abroad program (Figure 3). In addition, the structure of the short-term interaction program was outlined. The short-term exchange is realistic considering the ease of participation because of reduced financial costs and

the effect on many students, and as a result, it continues even now. In many cases, short-term exchanges have led to long-term study abroad and international work. The long-term study abroad program has immeasurable effects such as cross-cultural understanding and language learning effect, but the financial burden is large. From this, we think that it is important to focus on short-term exchanges and build a system that will lead to long-term exchanges and future work. Economic support such as scholarships and crowdfunding is also required in the mechanism, and it is possible to quantitatively show the benefits of long-term exchange and to create a transition from short-term exchange programs to long-term programs and global human resource development. This is a future issue. It is also an issue of evaluating programs in local governments that practice environmental engineering education programs outside Gunma prefecture.

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