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Design and Implementation of Youth Engineering Adventure Program in Korea*

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Despite the importance of engineering, young students in Korea are not exposed to a proper engineering education until they enter college to major in it. This situation leads to difficulty in recruiting talented students to colleges of engineering. In this paper, we first review various youth engineering programs in the UK and US. Next, we present the design and implementation a youth engineering adventure program (YEAP) for Korean students. Most young people who participated in YEAP were satisfied, and they responded that their interest in engineering increased. We expect that YEAP can eventually contribute to national industry development by increasing young people's interest in and enthusiasm for engineering.

Keywords: youth engineering education; engineering experience program; YEAP

1. Introduction

Engineering is an important area that is directly connected to a country's future. Engineering today is characterized by both the rapidly increasing diversity of the demands made on engineers in their professional lives and the ubiquity of the products and services they provide [1]. In particular, engineering education is critical to the quality of life and national competitiveness. In view of this, engineering education in secondary schools is undergoing a period of significant change in many countries [2]. Throughout the world, engineering education research has experienced remarkable expansion in recent years [3]. Hasna and Clark [4] analyzed young people's interest in science and technology across European counties. This trend is also apparent in Korea. Secondary school students in Korea are not effectively exposed to a proper engineering education until they enter college and major in it. During secondary school, the curriculum is designed so that students spend most time on natural sciences, such as physics, chemistry, earth science, and mathematics In addition, engineering is not required for college entrance examinations; Korea has been experiencing difficulty in recruiting high-quality college students in engineering fields because of a recent trend to avoid these areas [5]. According to a survey of students in 688 high schools in Korea, 54% of the students who selected science majors in high school majored in science or engineering in college as they intended; 33% majored in medicine/pharmacy and 13% chose law or business administration as their college major [6].

Many researchers have investigated several aspects of engineering education programs in secondary school. Hylton and Otoupal [7] investigated engaging secondary school students in pre-engineering studies to improve skills and develop interest in engineering careers. McCuen and Yohe [8] studied engineering design for secondary education. Gregg and Chen [9] studied secondary engineering education at a college summer camp. Williams et al. [2] mentioned that problem-based learning in technology education is becoming popular among teachers. Cantrell et al. [10] studied the effects of engineering education modules on student learning in middle school science classrooms. Each module included lesson plans, a Web simulation, and three assessments. In addition many engineering experience programs are now available for secondary school students. In the US, ASEE (American Society for Engineering Education) [11] leads these programs, while in the UK RAENG (Royal Academy of Engineering) [12] runs the BEST (Better for Engineering, Science and Technology) [13] program, which includes programs for secondary school students. Korea, which is on a faster track to technology development, is moving toward establishing such initiatives.

The main purpose of this paper is to design and implement a YEAP (Youth Engineering Adventure Program) to inspire young Korean students, who will lead technology advances in the future, by providing them with a chance to experience engineering. As a consequence, we hope that engineering programs will be able to draw talent to engineering and technology development.

In this study, we first review the youth engineering activities of advanced countries, such as the UK and US, and next introduce a youth engineering adventure program that is appropriate to Korea.

We expect that, by increasing their interest in and enthusiasm for engineering fields, talented young

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students will be encouraged to study engineering and will eventually contribute to national industry development.

This paper is organized as follows. Section 2 reviews the youth engineering activities of Korea, the UK, and the US. Section 3 introduces the Youth Engineering Adventure Program for Korea. Section 4 analyzes the effect of the Youth Engineering Adventure Program, and Section 5 contains a discussion and conclusion.

2. Youth engineering programs in the UK, US, and Korea

2.1 Youth engineering programs in the United Kingdom

In 2005, the 'Shape the Future' initiative was launched by RAENG in the UK. As a promotional tool for technology and engineering in schools, 'Shape the Future' attempts to maximize impact, create leverage, and effect coherence in the crowded marketplace (RAENG, 2008) [14]. Since 2008, RAENG has published the Shape the Future: Directory of Engineering and Technology Enrichment Activities for Schools and Colleges. In this document, more than 60 programs classified by age and time commitment have been introduced [14]. Other organizations supporting the 'Shape the Future' initiative include Primary Engineer and BA (British Association for the Advancement of Science) [15].

Various programs are available for different student age groups. Here we discuss programs covering age groups through secondary school: Primary Engineers [16], Young Engineers Clubs [17], CREST Award (Creativity in Science and Technology) [18], Smallpeice Trust [19], and Headstart [20].

The Primary Engineer program teaches 5–11 year olds and their teachers about engineering. In particular, Primary Engineer has worked nationwide in developing sequential courses so that teachers can build confidence in presenting lessons about design technology involving mathematics and science. Primary Engineer courses have two aspects: a highly productive hands-on curriculum for the day and resources for teachers to support the program in the classroom [16].

Young Engineers is a national network of science, engineering, electronics, and technology clubs in schools and colleges throughout the UK, focusing on 7–19 year old students. Young Engineers' purpose is to inspire young people to recognize the importance and excitement of a career in engineering. Students of all abilities participate in the application of science, engineering, and technology to real-life problems, extending their work beyond the classroom curriculum and developing core skills in teamwork, communication, and numeracy [17].

The Smallpeice Trust, part of the BEST (Better Engineering, Science, and Technology) program, focuses on 13–18 years old. It provides support for two activities. First, there is a science, technology, engineering and math (STEM) session to explain the engineering field to high and middle school students. Second, there is a residential engineering course during which young people reside at university for four days with new employees in the industry. In that program, new employees introduce engineering fields, and young people participate in real projects from enterprises created by new employees [14].

Headstart focuses on 16–17-year-olds and is part of the BEST program. Headstart's aim is to encourage students interested in mathematics or science to consider technology-based careers. This program is held at a university for four days. In contrast with Smallpeice, in the Headstart program, professors participate in the program. Students are involved in practical problem-solving activities, watch lectures and presentations, visit local companies, experience university life as an undergraduate, and learn about the challenges and rewards of science, engineering, and technology [14].

The BA CREST Award focuses on 11–19-year-olds and encourages students to develop scientific curiosity, as well as problem-solving and communication skills. In addition, students can link into work experience placements, after-school clubs, or several-linked schemes. Students can also investigate or design and make a product, research a subject, or design a science communication project. The BA CREST awards are available in two subject areas—Science and Technology—and at three levels: BRONZE (involving around 10 hours of project work and intended for students 11–14 years old); SILVER (involving 40 hours of project work, intended for students 14–16 years old, and often linked to industry); and GOLD (with 100 hours of project work and intended for students older than 16 years) [14].

Donghong and Shunke [21] mention that British Association's Young People's Program aims to engage and inspire young people with science and technology and its implications. BA CREST Award is well-designed award schemes for young people of all ages. In addition, the authors indicated that this non-formal education is an important supplement to formal education, and has been attracting more and more attention in many countries.

2.2 Youth engineering programs in the United States

As in the UK, many engineering programs for young people are available in the US. Among them, we review the K-12 engineering education program. The Engineering K12 Center of the American Society for Engineering Education (ASEE) seeks to identify and gather in one place the most effective engineering education resources available to the K-12 community. K-12 engineering education focuses on three main questions. First, what are realistic and appropriate learning outcomes for engineering education in K-12? Second, how might engineering education complement the learning objective of other content areas, particularly science, technology, and mathematics, and how might these other content areas complement learning objectives in engineering education? Third, what educational policies, programs, and practices at the local, state, and federal levels might permit meaningful inclusion of engineering at the K-12 level in the U.S.? [22].

ASEE operates the Engineering K-12 Center. Recently, ASEE announced the eGFI (engineering, Go For It) brand. Highlighting the eGFI is a colorful, inspiring web magazine designed to attract middle-school and high-school students, particularly minorities and young women, and their parents, teachers, and counselors to the exciting world of engineering and technology. On this web magazine, we can obtain various kinds of information about engineering. eGFI has many active programs divided into three levels by grade level: grades k-5, grades 6–8, and grades 9–12. They have a total of 144 programs [23].

The Engineering K12 Center works to enhance achievement in pre-college science, technology, engineering, and mathematics (STEM) education by promoting the effective application of engineering principles to the K-12 curriculum. These objectives have been accomplished with the long-term support of the National Science Foundation (NSF).

Jesiek et al. [2] reported that the National Academy of Engineering (NAE) and NSF are providing important symbolic and financial support for related work. Denton [24] mentioned that the 'NSF has supported Engineering Research Centers (ERC's) which focus both on interdisciplinary research and on the integration of research and education.' The author also cited the K-12 student population as a critical source of the US undergraduate student body. The aim of the NSF is to promote new knowledge creation and the prosperity of the STEM field by investing public funds in science, engineering, education, and technology. Jeffers et al. [25] investigated the contribution of K-12 engineering outreach programs on the increase of interests that K-12 students have for math, science, and engineering. The authors summarized various outreach programs based on unique features and these programs are divided into type such as classroom materials, web-based resources, outreach activities on campus, and professional development.

In various programs supported by the NSF such as Discovery Research K-12 (DR-k12), NSF Graduate Teaching Fellows in K-12 education (GK-12) the programs are related to K-12 engineering education. DR-K12 consists of 46 to 66 awards, and GK-12 consists of about 21 awards annually.

The Discovery Research K-12 (DR-K12) program seeks to enable significant advances in pre-K-12 student and teacher learning of the STEM disciplines through the development, implementation, and study of resources, models, and technologies for use by students, teachers, and policymakers. Activities funded under this program begin with a research question or hypothesis about effective pre-K-12 STEM learning and teaching; they then develop, adapt, or study innovative resources, models, or technologies; and finally they demonstrate if, how, for whom, and why their implementation affects learning.

GK-12 provides funding for graduate students in NSF-supported science, technology, engineering, and mathematics (STEM) disciplines to acquire additional skills that will broadly prepare them for professional and scientific careers in the 21st century. Through interactions with teachers and students in K-12 schools and with other graduate fellows and faculty from STEM disciplines, graduate students can improve communication, teaching, collaboration, and team-building skills while enriching STEM learning and instruction in K-12 schools. Through this experience, graduate students can gain a deeper understanding of their own STEM research.

2.3 *Youth engineering programs in Korea*

Korean youth engineering education programs can be improved by following the models of those in advanced countries, such as the UK and the US. The Korean education curriculum has three engineering education tiers leading to development: technology education in primary, middle, and high school; industrial education in technical high school; and engineering education in engineering colleges. These three education tiers are necessarily interrelated.

In addition, Cho [26] mentioned in the seventh curriculum in Korea that there were pressing problems because of a lack of practice hours in engineering education. In particular, the high school curriculum does not accommodate a separate curriculum for engineering, and engineering subjects are not covered in the national academic aptitude test. This lack of contact with engineering in secondary education may be responsible for a widespread engineering avoidance phenomenon [27].

In Korea there are a number of extracurricular engineering education programs, such as Women into Science & Engineering (WISE) [28] and Junior Engineering Achievement [29], among others. Most of these programs exist to complement regular education courses in schools that have insufficient contexts. The details of these engineering programs are as follows:

1. Women into Science & Engineering (WISE) is a program that develops and supports a step-by-step program from primary school to the university for female students who have a talent for math, science, engineering, and technology. WISE consists of a mentoring program of secondary female students. The mentoring program is constructed such that a mentor (a female professor, researcher or undergraduate student) gives advice to a mentee (a female secondary or undergraduate student). In the mentoring program, WISE also holds a research competition.
2. Junior Engineer Achievement (JEA) of the National Academy of Engineering of Korea is an engineering education program focused on primary school students. With the help of the engineering industry, JEA aims to educate primary school students with cutting edge science and engineering content.
3. The youth industrial technology camp of the Korea Institute for the Advancement of Technology provides primary, middle, and high school students with experience at an industry site so that they can be involved in the design process. In this way, the program seeks to help provide an understanding of the industry and the attractiveness of engineering.

What is still missing is a program involving university activities that invites secondary school students to a school of engineering to introduce them to engineering majors and give them a chance to interact with engineering professors. We propose the Youth Engineering Adventure Program (YEAP), which can serve that purpose.

3. Youth Engineering Adventure Program (YEAP)

The Youth Engineering Adventure Program (YEAP) is designed for secondary school students. It takes the form of experiential learning, as in the UK cases reviewed in Section 2.1. Experiential learning means that the student is expected to be an active learner and that the teacher's coaching role focuses on the student's activities. In addition, this educational concept consists of three components: knowledge, activity, and reflection [30, 31].

As displayed in Table 1, YEAP consists of three parts: introduction of the engineering major, experiential learning with engineering major, and a campus tour. During the introduction session of the engineering major, a professor introduces the field of the engineering major and the university. Experiential learning with the engineering major follows after the professor's introduction of the major. This takes the form of either experimentation or a game and is conducted with the help of both professors and graduate students. The objective of experiential learning is to increase the secondary school students' interest in the engineering major. Through this process, we expect that secondary school students will better understand the engineering major. Lastly, a campus tour is conducted to help students learn about university life.

As a test program, two engineering professors (Industrial Engineering and Electric Engineering) and one chemistry professor, all of whom are active in youth creativity education, participated in three different programs. A detailed explanation of these three major experiential learning projects is displayed in Tables 2–4.

For instance, the main purpose of Six Sigma games for Industrial Engineering is to provide students with ample opportunities to realize not only the importance of quality in the product design and development phase but also that of project management and technology management. The main targets in this study are any students who have the potential to be involved in the area of engineering but it is mainly to introduce industrial engineering. The Six Sigma game is designed for making a product taking into consideration a variety of constraints in the given time and using only the allowed components. Products made by individual teams are evaluated in the aspects of sigma level of defects, reliability, durability, production cost, marketability, design, ethics and competitiveness. In this situation, members participating in the game are faced with various problems such as the trade-off between defect rate and cost and that

Table 1. The process of YEAP

Procedure	Event	Supervisor	Time (minutes)
1	Introduction to engineering major	Professor, graduate students	40
2	Experiential learning for engineering major	Professor, graduate students	60
3	Survey for evaluation	Professor, graduate students	20
4	University campus tour	Graduate students	30

Table 2. The contents of experiential learning for Industrial Engineering (IE) designed by Professor S. Y. Sohn at Yonsei University

Title	Six Sigma game of industrial engineering.
Subject	With Lego parts in a limited period of time, make a toy for infants (year 4~7), which has a length of 25 cm and a height of 15 cm; it should be a transportation vehicle such as a car, a motorcycle, or other moving vehicle. Recognize the importance of design, manufacturing technology, economical efficiency, and team management technology.
Learning effect/ expectation	Students are faced with a problem that involves handling the defects, time, cost, resources, and marketability of a product with given parts. Through this process, students can actually experience a real situation involving quality management, schedule management, economic efficiency, optimized design, and time management in the product development stage.
Related theory	Six Sigma, Marketing, Quality engineering, Decision analysis.
Present of advanced assignment	Think of several fields in which Six Sigma is applied and search for new application domains for Six Sigma.

Table 3. The contents of experiential learning for Electrical and Electronic Engineering (EE) designed by Professor K. S. Jang at Korea University

Title	Simulation of electrical and electronic engineering.
Subject	The aim is for students to learn basic principles about current, voltage, and electric power through a basic experiment of electrical and electronic engineering; they can study the basic principles for the production and transfer of electricity through a computer simulation using an electricity energy system, including both solar energy generating and wind power generating elements.
Learning effect/ expectation	We expect that students can understand renewable energy and the production of electricity through experiments and simulation.
Related theory	Basic theory of electric circuits (Ohm's law, Kirchhoff's circuit rules and so on), basic theory of electromagnetic fields, and basic theory of power engineering.
Present of advanced assignment	Calculate the total amount of electric power in the house and find the relationship between the total amount of electric power and electric charges by month. Observe the change in electric charges by using the pattern of a special instrument.

Table 4. The contents of experiential learning for Creativity Engineering (CE) designed by Professor J. H. Choi at Hanyang University

Title	An experiment consisting of engineering and industrial technology.
Subject	Based on the scientific principles and content of secondary school curricula, students learn to apply and adapt industrial technology.
Learning effect / expectation	Students will learn diverse knowledge about engineering because it engages experiential learning related to several engineering majors, such as electrical and electronic engineering, mechanical engineering, biotechnology, metallurgical engineering, and architectural engineering.
Related theory	Creativity theory.
Present of advanced assignment	On the basis of an understanding of creative engineering technology and knowledge obtained through the experiment, submit a new and creative idea about engineering technology.

between cost and design, which are basically influenced by choosing different raw material (raw material). Ultimately, through the process of the game, students are expected to learn the importance of quality engineering, technology management and project management.

The YEAP web site was used to announce the programs so that any interested individual student can join the program. At the same time, professors responsible for each program contacted local schools to invite young students. Each program took five hours and was repeated three times from November 2007 to October 2008. Each program invited more than 20 secondary school students who expressed an interest in engineering. A total of 184 students who were middle or high school students participated in YEAP. To examine the impact of YEAP, we conducted a survey of the participating students.

4. Analysis of the impact of the Youth Engineering Adventure Program

4.1 Survey description

We surveyed 184 students after they participated in YEAP. The survey consisted of ten questions about the contents of experiential learning and the change of the student's perception of engineering. Of 184 students, 79 students were male and 105 students female. In addition, there were 33 middle school students and 151 high school students. The numbers of students by gender, school type, and engineering major for experiential learning are shown in Table 5.

Each major had more than 60 participants. In the IE program, middle school students participated, and most students were male, while high school participants were mostly female. In EE, the gender ratio was almost one to one. In CE, there were more than twice as many female participants as male.

Table 5. The number of students by gender, school type, and engineering major program

			School	
Major	**Gender**		**Middle school**	**High school**
IE	Male		27	7
	Female		6	24
		Total 64		
EE	Male		0	27
	Female		0	33
		Total 60		
CE	Male		0	18
	Female		0	42
		Total 60		

4.2 Survey results

(a) Reason why they participated in YEAP

Students explained why they participated in YEAP. As shown in Fig. 1, the main reason that students participated in the EE program was to gain university experience. The next most popular reasons were curiosity and a desire for experimentation experience. Meeting a role model and receiving career counseling ranked lower. In three programs, university experience, curiosity, and experiment experience were selected as major reasons why students participated in YEAP. In addition, career counseling and meeting a role model were assigned as minor reasons.

(b) The main benefits from YEAP

Next, we surveyed the primary benefits of YEAP. Students answered that university experience, acquisition of information regarding the engineering major, and experimental experience were the main benefits. The results for the main benefits was slightly different from the reasons for participation. For IE, the acquisition of information regarding the engineering major was the greatest benefit, whereas, for EE, university experience, and for CE, experimentation experience were the greatest benefits. These findings might be due to the nature of IE, which is not relatively well known to secondary students, compared with the other engineering majors. In all the programs, curiosity was seen as having less benefit while the acquisition of engineering technology knowledge, career counseling, and meeting the role model were considered to provide more benefit than expected. Moreover, based on the top four benefits (university experience, experiment experience, major information acquisition, and the acquisition of engineering technology knowledge), we can see that participating students thought that actual experience was the most important thing in YEAP.

In Table 6, students' responses to other questions about the YEAP experience are displayed. Detailed information is as follows.

As for their satisfaction with the content and methods of education, about 91% of all students replied that they were satisfied with YEAP. More than 92% of students who participated in IE replied that they were satisfied with the engineering major

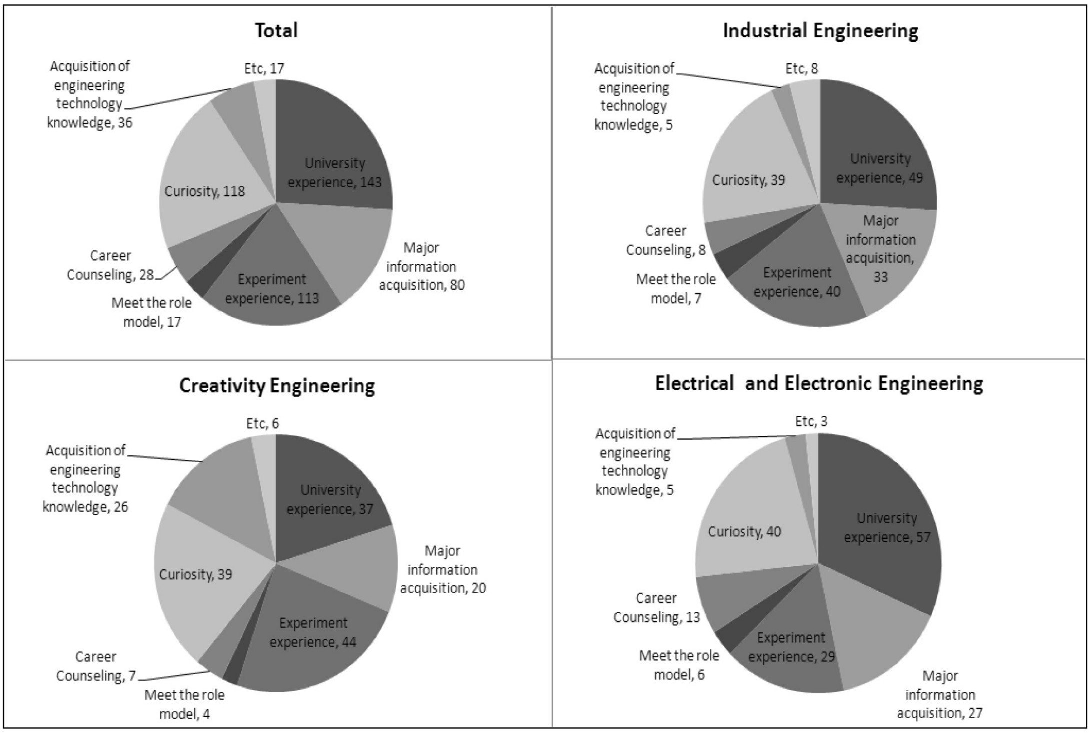

Fig. 1. Reason to participate in engineering experiential learning (students).

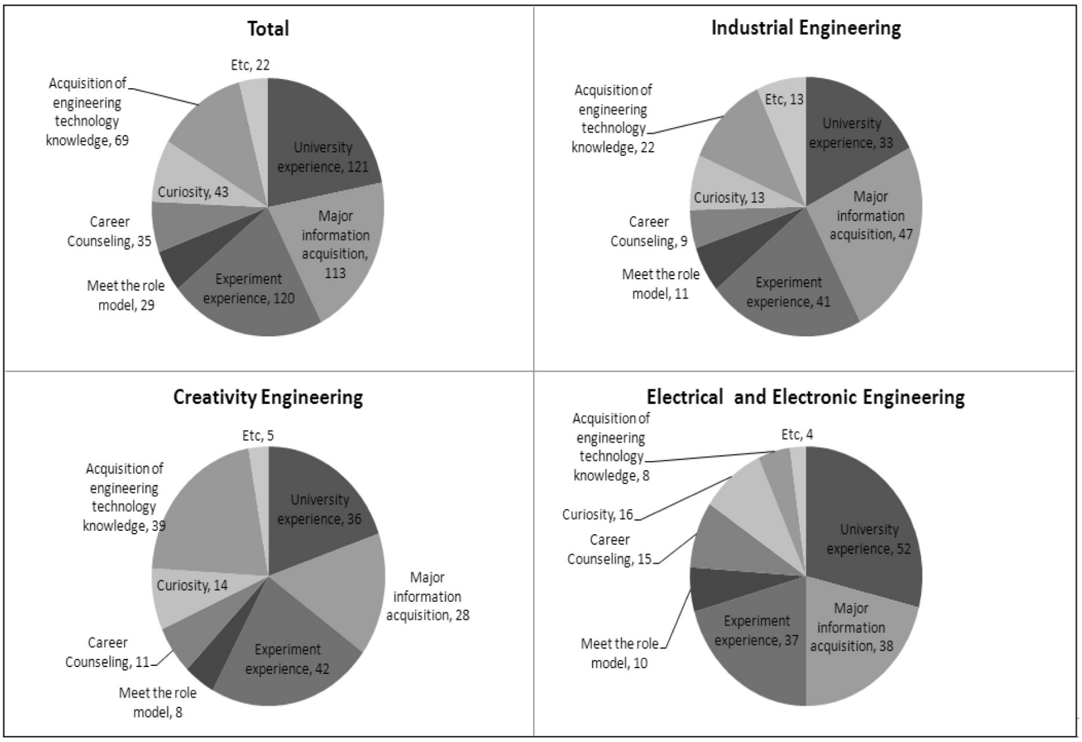

Fig. 2. The main benefits from YEAP (students).

Table 6. Responses frrom students' YEAP experience

		Response (%)				
Questions	**Major**	**Very negative**	**Negative**	**Average**	**Positive**	**Very positive**
Satisfaction with YEAP contents and teaching tools	IE	0	0	8	49	43
	EE	0	2	5	46	47
	CE	0	0	11	56	33
	Total	0	1	8	41	50
Degree of comprehension of YEAP (Answer: Very difficult to Very easy)	IE	0	14	51	32	3
	EE	0	3	17	60	20
	CE	2	8	28	44	18
	Total	0	5	20	52	23
Degree of information acquisition of engineering, as compared with that before participation	IE	0	2	9	49	40
	EE	0	0	18	54	28
	CE	0	2	21	48	29
	Total	0	1	16	50	33
Curiosity increase about relevant major after attending YEAP	IE	0	1	13	62	24
	EE	0	0	12	60	28
	CE	2	0	21	51	26
	Total	0	1	15	58	26
Comprehension of relevant major, as compared with the expectation. (Answer: very difficult (left) to very easy (right))	IE	0	0	21	55	24
	EE	0	0	30	48	22
	CE	2	11	20	52	15
	Total	1	4	23	52	20
Intention of choosing engineering as University major after YEAP	IE	2	3	28	48	19
	EE	0	0	25	45	30
	CE	2	7	34	23	34
	Total	1	3	29	39	28
Want to learn a little more specific about Engineering Want to know more about engineering	IE	0	2	21	49	28
	EE	0	2	13	40	45
	CE	0	0	21	43	36
	Total	0	1	19	44	36

experience. In particular, 43% of students replied that they were very much satisfied with it. Similarly, about 92% of students who participated in EE experiential learning replied that they were satisfied with the engineering major experience. Among them, 47% of students replied that they were satisfied with it. As for CE experiential learning, 89% of students were satisfied with the experiential learning, and 39% among them replied that they were very satisfied with the engineering major experience. Therefore, most of the students were satisfied with the content and educational methods and thought that the curriculum was appropriate.

About 75% of all students replied that they could easily understand the content of the engineering major. Therefore, the YEAP experience is expected to contribute more in-depth information. About 32% of students who participated in IE experiential learning replied that they could understand the engineering major easily, while 51% replied that they faced a moderate amount of difficulty in understanding it. In addition, about 80% of students who participated in EE experiential learning replied that they could easily understand the engineering major. As for CE experiential learning, 62% of students replied that they could easily understand the engineering major experiential learning. Therefore, EE and CE were more difficult for students.

About 83% of the students replied that they had more engineering information after participation than before. Seventy-seven percent of participating students replied that they acquired a significant amount of engineering information about their particular major. This result suggested that almost all students were satisfied with the YEAP's contents.

About 84% of all students replied that their curiosity about their experiential major increased by attending YEAP. In particular, about 86% of students who participated in IE replied that their curiosity about the major increased by attending YEAP. About 60% of students who participated in EE replied that their curiosity about the major increased by attending YEAP. Fifty-two percent of students who participated in CE responded that their curiosity about the major increased by attending YEAP. From these responses, one can see that student curiosity changed differently for each major.

About 72% of all students replied that they could understand YEAP easily, contrary to their expectation. However, in the case of CE, students had a lower comprehension of the content. In particular, 13% of students replied that CE was very difficult or difficult. Comprehension of the relevant major compared with student expectation differs among IE, EE, and CE.

Of 184 students, 67% replied that they intended to choose engineering as a university major after YEAP. Among students who participated in IE experiential learning, 67% reported an increase in their desire to choose engineering as a university major after YEAP. Among them, 19% responded that their desire to do so increased very much. In contrast, for EE, 75% replied that their willingness to go into the engineering field after YEAP increased. Among them, 30% replied that their willingness increased very much. Opinions of students who participated in CE are diverse. Fifty-seven percent responded that their desire to choose engineering as a university major after YEAP increased considerably, and 34% responded that their desire to do so increased moderately. However, 9% responded that their willingness did not increase.

Eighty percent responded that they wanted to know more about engineering in more detail after YEAP. Among the students who participated in IE experiential learning, 77% responded that they wanted to know more details about engineering, whereas for EE 85% replied that they wanted to know more about engineering. Lastly, among students who participated in CE experiential learning, 79% responded that they wanted to know more about engineering. This result suggested that YEAP contributed to increasing student interest in engineering.

In Table 7, students responded that they felt uncertainty in planning to study engineering at college because of insufficient information about the relationship between the major and jobs in the field. In addition, students responded that information about the engineering major had been insufficient and opportunities to obtain advice about careers were limited.

When we analyzed the survey results, we found that students had limited information about engineering; thus, they faced difficulty in deciding whether to major in it. To most survey questions, students responded positively in regard to the contents of YEAP. Therefore, we can say that YEAP was a success. In particular, students responded most positively to the question as to how much

Table 7. Causes of difficulty in deciding to study engineering in college.

Answers	Ratio (%)
Insufficiency of information about the engineering major.	30
Insufficiency of information about the relationship between the major and jobs.	41
Insufficiency of advice about career. opportunities	22
Other	7

information they acquired. In addition, we did not find different trends by engineering major, excluding the reason for participation and the main benefits of YEAP.

5. Conclusions

In this paper, we attempted to make qualitative improvements to engineering by counteracting some of the reasons, such as lack of information, that some students avoid engineering as a field of study. To do so, we reviewed the activities for youth engineering education in the United Kingdom and United States. From these programs, we proposed the youth engineering adventure program (YEAP) for secondary students in Korea.

The response of students to implementation of the three programs was positive. Students who took part in YEAP mentioned that the main advantages were the university experience, the acquisition of information about the engineering major, and experimental experience. In addition, we found on the basis of the students' surveys that each major's performance was different.

Based on the survey results, we obtained valuable feedback information. The level of satisfaction with YEAP contents and teaching tools indicated that the experience learning program we proposed is considered to be suitable for secondary school students. In addition, we found some areas that need improvement. In particular, CE should focus on students' comprehension in experiential learning and introduction of the engineering major. In addition, level of difficulty should be slightly adjusted by each program. Participating students in the IE program replied that they had easily comprehended the program. However, the contents of EE were perceived to be more suitable than those of CE and IE. Students' intentions of choosing IE and CE as a university major after attending YEAP were less than that of EE. Therefore, these major programs should focus more on improving students' desire to choose engineering. However, in general, based on the results of survey questions such as Intention of choosing engineering as University major after YEAP, Willingness to learn more about engineering, overall performance of YEAP is acceptable. Lastly, students left with insufficient information about the relationship between engineering majors and jobs in the field.

In this paper, we focused on the design and implementation of YEAP for secondary students in Korea. While our analysis yields valuable information, much additional work is needed. The results of our multidimensional survey can be further analyzed to investigate the causal relationship among several factors.

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