

# **ESTABLISHMENT OF AN EDUCATION PROGRAM PARTICIPATION PLAN STRATEGY THROUGH DATA ANALYSIS BETWEEN PARTICIPATION IN UNIVERSITY REGULAR COURSES AND EXTRACURRICULAR PROGRAMS AND EMPLOYMENT PERFORMANCE**

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## **Abstract**

Since university education is centered on a competency-based education such as the National Competency Standards (NCS) or the university's core competencies established by the government or the university, it is necessary to analyze which competencies can positively affect the smooth employment of graduates. This study analyzed the relationship between core competencies and employment of students who completed the competency-based curriculum and extracurricular programs for graduates of Y University in Korea and analyzed what was needed for each major's curriculum improvement, such as the most effective program and specific programs suitable for each student level from admission to graduation, and university education policy. For instance, how educational input variables, such as GPA and core competency achievement by taking several regular and extracurricular programs at graduation, affect educational performance variables such as whether they are employed and the quality of their place of employment. The results of this analysis can be used to share optimized methods and tasks that can increase the employment rate and cultivate our students with the skills and attitudes that society asks for by

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developing customized programs and participating in effective programs for each department or major in the next year.

### **Keywords**

Competency-based education, employment, educational effect, statistical analysis, machine learning.

## **INTRODUCTION**

The Fourth Industrial Revolution, which is breaking down the boundaries of various spaces, such as physical and virtual spaces based on various cyber-physical technologies, is causing significant societal changes, including human lifestyle and job structure in the labor market. In particular, it is expected that new jobs and industries will emerge due to the introduction of new technologies. In addition, efforts are being made to revitalize the sharing economy and platform by introducing a wage and replication system that can support various types of work and create new jobs using new technologies (Park & Kim, 2022).

Universities are introducing differentiated and innovative education systems and developing and operating content based on mid- to long-term development plans, such as university specializations and field-oriented education introduction, to nurture talents required by society and industry in line with these changes. Based on the *Junior College Development Project*, a competency-based curriculum is being operated according to the National Competency Standards (NCS), and as of 2017, 100 schools are operating (Kim et al. 2018). Based on the preceding project, *Junior College Development Project*, and the *Junior College Innovation Support Project* in the follow-up project, a specialized competency-based curriculum based on the core competencies set by the university is being expanded and reorganized to major/general arts and extracurricular programs.

However, as the school-age population is rapidly declining due to changes in Korea's demographic topography, restructuring of universities is indispensable (Lee, 2021). Efforts are being made to expand custom education to educate the talents that society demands and to reorganize education to teach students what they want. However, these policies have limits to fundamentally solving the problem of admission resource shortage. Moreover, as the ratio of middle school and high school students with level 3 (average academic ability) or beyond continues to decrease, and as the ratio of students with level 1 (less than essential academic ability) increases, students with low basic academic skills are likely to enter colleges (Sung, 2021). COVID-19 has accelerated this phenomenon, and the primary competency required for higher vocational education in the existing junior college competency-based curriculum (including the NCS-based curriculum) has recently declined. Therefore, various extracurricular programs have been carried out simultaneously to guarantee the right to study the primary competency (Oh & Kim, 2021).

Regarding the effectiveness of the extracurricular programs, there were positive results across educational effectiveness and university management, indicating higher grades after participating than before participating in the program or student wastage rates (Hwang, 2019). Similar results have been found in other studies. In a study conducted by Massoni (2011), extracurricular programs also have been found to have a positive effect on students' academic achievement with increased competencies such as knowledge, attitudes, and behaviors and a decrease in student wastage rates at university.

As such, many discussions by universities are continuously being made about whether the competency-based curriculum or extracurricular programs have educational effects respectively, and how these programs should be placed in students' curriculum organizationally considering the best

way. Many universities publicly share their challenges to these issues and also some solutions (Kim, 2021; Son et al., 2022). Each university defines its core competencies and operates competency-based education programs that strengthen liberal humanities and job competencies that professionals should have. In the case of Y University, used in this study, the slogan TRUST Education was defined. TRUST core competencies were defined by taking each letter under the educational philosophy of nurturing conscientious talents. Regarding the TRUST core competencies, Trustworthy competency (finite personality competency), Ready competency (basic learning competency), Useful competency (basic job competency), Specialized competency (job performance competency), and Tested competency (primary employment and entrepreneurship competency) were defined as five core competencies that Trustful Talents (TRUST) should have.

All regular courses and extracurricular programs are divided into subcategories for each core competency, and a certificate is offered to encourage participation. However, as the direction of operation is determined based on the educational philosophy of most instructors and PMs for each program, these programs need to be more pre-evaluation review on what aspect of educational effectiveness should be included based on their related core competency. In particular, as non-face-to-face regular curriculum and extracurricular programs are operated after the 2020 school year due to COVID-19, different effects from the existing face-to-face education operation performance are expected to be derived. Alternatively, preparing primary data for non-face-to-face operations in the future is necessary. In the case of other universities, an analysis of the operation status of extracurricular activities through university student surveys (Yeon & Ahn, 2021), an analysis of the academic motivation of students participating in academic promotion extra-curricular programs, and an identification of targets for intensive

support (Park & Yoon, 2021), and effective operation through analysis of participants' perceptions of university extracurricular programs. Although the program's effectiveness was analyzed centering on self-surveys such as research and design plans (Cho, 2021), analysis in conjunction with university key performance indicators is necessary to identify the characteristics of competency-based regular courses and extracurricular programs at a macro level.

Based on the need for the above research, this study conducted several data analyses, such as which extracurricular programs are adequate for our major students for job recruitment, that can derive effective feedback from preparing the regular and extracurricular programs in the next year. By performing quantitative and qualitative correlation analysis of employment status according to participation in competency-based curriculum and extracurricular programs of graduates of Y University from 2017 to 2020, several guidelines, including which extracurricular programs should be opened in the university, which regular courses are needed for our students, which extracurricular programs is not needed for our students, were suggested for the following year's education operation and participation well. In particular, the performance management model and methodology of higher vocational education were developed based on detailed analysis, such as the relationship between the rate of strengthening core competencies and the employment rate by year, the relationship between employment status according to completion of the competency-based regular courses and extracurricular programs, and the relationship between core competency achievement and the quality of employment. Lastly, the effectiveness of the regular curriculum and extracurricular programs was checked according to the characteristics of each major, respectively, to derive an educational method optimized for cultivating talented people required by society.

## **RESEARCH BACKGROUND**

The core competency defined in higher vocational education is more comprehensive than the job competency of professional workers. However, it includes humanities literacy and common competencies humans should have in modern society (Kim & Oh, 2022). Based on these fundamental characteristics, universities are establishing competency models based on the knowledge, skills, and attitudes required by local communities and industries and establishing tasks to nurture excellent talents (Park, 2008).

In Y University, the subject of this study, core competencies were defined as five primary competencies by linking the core competencies developed in the NCS base center's study of junior colleges with the university's mid-to-long-term development plan (Kim, 2020). Five core competencies that diligent talents should have were defined, sub-competencies were defined according to the categories of core competencies, and competency-based education was applied to curriculum and extracurricular programs department (Table 1).

### **Definition of the quality of jobs**

Employment of college graduates is defined as the performance of various complex factors, and personal background, academic background, and socioeconomic factors have been analyzed as factors influencing employment (Yum et al., 2017). In particular, studies have been conducted to find complex factors that sensitively affect complex factors by classifying them into specific groups such as gender, college major, and entrance classification. As employment performance is defined as a dichotomized performance indicator of the employed and the unemployed, advanced analysis is lacking. Performance analysis was diversified by utilizing the size of small, medium, and large enterprises, an average monthly wage, and satisfaction survey results (Moon & Hong,

2017). However, as a community where many job seekers and workers can discuss the company's working conditions and welfare activated due to the development of network technology, the standards for quality employment in the past are changing. In a recent study, the relationship between actual job satisfaction and company ratings is examined through the analysis of company review scores provided by Job Planet, a domestic online company review site, and online reviews can be used to predict the value of a company as non-financial information (Kim & Lee, 2021). Based on these facts, the employment status of students managed within the university is not judged simply as employment status, but rather how the status of completion of various regular and extracurricular programs experienced during study at university leads to the qualitative status of the place of employment. It is necessary to derive an educational curriculum tailored to students by analyzing how it affects students.

In this study, using the name of the place of employment and business registration number specified in the results of the employment statistics of graduates of higher education institutions of students who graduated last in each relevant year, the company's review score on the Job Planet site was web-scrolled and mapped by a student to find the place of employment. A qualitative analysis was conducted. By applying external evaluation data such as welfare and salary, work-life balance, company culture, promotion opportunities, and possibilities, rather than a simple self-survey on graduates' employment, the current state of university education and the direction of improvement can be sought.

## **Concept of machine learning**

Data analysis is used to find insights into meaningless data generated by various groups such as companies, universities, and institutions (Kim, 2014). Advances in data analysis are

closely related to the development of statistics and computational power. Numerous calculations have been made using computers to present theoretical and mathematical models in inferential statistics to predict what will happen in the future. The field of merging statistics and computer calculations is called machine learning. Representatively, algorithms such as regression analysis and decision trees are known as mainstream technologies in machine learning.

Machine learning has been derived from various private fields and applied to streamline manual work in business, such as customer arrangements in banks. Recently, as artificial intelligence equipped with deep learning has been incorporated, the technology has been grafted onto offline and online services, replacing human knowledge labor. When about these applications, machine learning and artificial intelligence should be able to understand them well as they replace many parts of humans.

Machine learning presents trends and prediction models between data by functionalizing the relationship between specific data (Janiesch et al., 2021). Machine learning is divided into supervised learning, which learns the correct answer in advance, and unsupervised learning, which is the opposite. Supervised learning is divided into regression, which predicts output variables using input variables by finding the characteristics of output variables, continuous values, and classification, which applies the same concept to discrete output values. In the case of unsupervised learning, it is included in unsupervised learning as a technique of expressing a group of values with similar characteristics among data as clustering. Of course, recently, various techniques to increase the accuracy of predictive models, such as reinforcement learning and generation, have been proposed. Sufficient analysis is possible with machine learning.

In this study, an in-depth analysis was conducted on the subject and subject of analysis in the next section by utilizing



frequency, correlation, regression, and non-hierarchical cluster analysis techniques among machine learning techniques based on general matters. This research aims to not only verify the significance between education input and output variables but also derive meaningful results, including how to operate each educational program or which major should take the specific extracurricular program for effective education by machine learning.

## **METHODOLOGY**

The data input for this study was collected from Y University graduates' academic and employment information. Students who attended 2017 to 2020 as their last school year and graduated from February 2018 to February 2021 were selected as subjects. In order to understand the characteristics of each year, the analysis was conducted by dividing the year. The capacity building rate by university/department, whether students participated in regular programs and programs, and students' core competency achievement were defined as independent variables. The employment rate by university/department and graduates was defined. Employment status (Y/N) and the qualitative score of the place of employment obtained through web crawling were defined as dependent variables. As for the classification values of gender and field, which can classify student-related independent variables into specific groups, a detailed analysis was not performed due to various characteristic changes by year, such as new and abolished departments. Table 2 shows the range of data used in the department-level analysis.

### **Analysis variables**

Tables 3 and 4 represent data independent and dependent variables used in the analysis. About the independent variables, the number of students who completed the school year

and graduated represents the same physical quantity as the number of graduates by year,  $N$ , mentioned above. Participation in regular and non-curricular programs is as specified in Table 3:  $a, b, c, \dots, n$ , each sub-program for each core competency of the university is operated annually, and  $N$  students decide whether or not to participate in each program. Accordingly, the corresponding variable was set as a binomial variable of participation/non-participation.

Regarding the achievement of the following competencies, as the importance of the entire regular curriculum and extracurricular programs may differ depending on the instructor and operating PM, an evaluation and completion point system grants points at each program's completion time. Accordingly, the variable was defined as a quantitative variable. Accreditation is defined as a discrete variable between accredited and non-certified, as certification is derived by comparing whether the competency achievement level acquired by each student exceeds the standard score for each core competency defined by the university. Lastly, academic achievement refers to GPA, a key indicator for classifying past students' significant competencies. Academic achievement ranges from 0 to 4.5 points, is a variable created by the grades of liberal arts/major subjects, and has been used as a criterion to evaluate students' job competencies. Therefore, it was applied as analysis data to compare the difference between past academic achievement-oriented and current competency-oriented education.

The dependent variable is divided into employment and the place of employment review score. In the case of employment, which is a binary variable, the employment status data announced annually by the national statistical agency based on health insurance subscriptions was used. At this time, it is not easy to calculate the employment rate data at the time of graduation, so there is a time difference between actual educational performance and employment performance. We

will discuss this problem by conducting a time series analysis with our survey for our graduate students. Regarding the employment place review scores, employment site review scores were analyzed using the Job-Planet website as an evaluation index for companies and organizations where they were employed. At this time, since there is no information on employment places in the data announced by the national statistical agency, the data indexed by the university's self-survey was indexed to enter the employment places for each student, and the web crawling technology was used to pull the review score into data frame format for each employment place automatically. Through this employment performance data, it is possible to analyze performance in various aspects, such as regression, classification, and clustering analysis.

## **Analysis topics and hypothesis**

In this analysis, we seek ways to effectively operate and participate in competency-based education by identifying the operational status of the competency-based regular curriculum and extracurricular programs and analyzing the relationship between employment and student success. Accordingly, each group tried to optimize the perspective of competency-based education by performing linkage analysis at the university/department/student level using independent and dependent variables. Therefore, after defining the following three core themes, we achieved the goal by conducting a detailed analysis of the themes and hypothesis.

**Topic 1:** Analysis of core competency enhancement rate and employment status by year (frequency and correlation analysis)

**Hypothesis 1:** Departments that participate more in regular courses and extracurricular programs to strengthen university core competencies have higher employment rates.

Topic 2: Quantitative analysis (correlation and regression analysis) between participation in regular courses and programs related to strengthening core competencies and employment status

**Hypothesis 2:** Regular courses and extracurricular programs, which influence students' employment status, differ by department.

Topic 3: Qualitative analysis between competency achievement and employment status related to core competency enhancement (correlation and cluster analysis)

**Hypothesis 3:** Each department has different core competencies that must be intensively strengthened to advance into good employment opportunities.

## **RESULTS AND DISCUSSION**

### **Analysis of core competency enhancement rate and employment status by the year**

As a result of graphing the distribution of the certification rate (accredited persons/total students) using certification status of students by year and department among independent variables and the employment rate (employee/total students) using employment status among dependent variables, and performing a correlation analysis (Fig. 2), a significant physical relationship could be derived between the two variables. In the early days of competency education (2017), the correlation between department certification and employment rates was less statistically significant. However, through institutional and program improvements in 2018 and 2019, the correlation index showed 0.4 or higher, satisfying the significance level  $p$ -value of 0.05 or less and statistically significant. A significant quantitative relationship was found. However, in 2020, a situation occurred where the relationship between the two variables needed to be more elegant again.

Due to COVID-19, most education and programs are operated non-face-to-face, which reduces the effectiveness of existing education and seeks an optimized education operation method. It was confirmed that this educational input and employment outcomes had a positive relationship.

In order to examine the relationship between the completion of each regular curriculum and extracurricular program and the employment rate, the employment rate was calculated by selecting students who completed each regular curriculum and extracurricular program rather than calculating the employment rate using the employment status of all students belonging to each department from 2017 to 2020. As a result of calculating and checking the list of programs in which departments with an annual average of over 70% have more than 10%, 46.7% of all departments meet the conditions for field practice within job performance competency. In the case of capstone design, among all departments, As the result of 10% meeting the conditions was derived, it was confirmed that completing the regular course positively affected student employment when viewed as simple participation. In the case of extracurricular programs, the number of students who participated in the Korean/English/Mathematics/Thinking ability diagnosis and reinforcement program within essential learning competencies was 23.3% and 33.3%, respectively. It was confirmed that guiding students to complete their major subjects typically positively affected the employment rate. However, in the case of employment rate analysis, it is assumed that they are the same without considering the characteristics of departments.

## **Quantitative analysis between participation in regular courses and programs related to strengthening core competencies and employment status**

Among the independent variables, correlation and regression analysis were performed through 1:1 matching between the completion of each regular curriculum and program of students by year and department and whether these students were employed. In this case, in the case of regular subjects and programs that are operated the same every year, the case where statistically significant trends are repeated is the standard, and in the case of abolition or new establishment that is not continuous, the case where significant results are derived in the corresponding year. Statistically significant criteria were applied: the correlation index was 0.3 or more, and the p-value was 0.05 or less. Table 5 is a list of departments that confirmed statistical significance among all regular courses and extracurricular programs, and the sporadic distribution for each program can be confirmed. However, in the case of the regular course and program, it was confirmed that it could be linked to a higher probability of employment if regular and extracurricular programs are recommended as they are core to the employment mechanism of department students. In addition, in the year of face-to-face operation, the similarity of compatibility between programs and departments was confirmed. However, in 2020, when it was operated as non-face-to-face, the trend changed very differently. Hence, it is necessary to analyze how the operating method in 2021 face-to-face, will affect the department in the future.

Second, among the independent variables, multiple regression and logistic regression analyses were conducted through N:1 matching whether students by year and department completed multiple N of each regular curriculum and program and whether these students were employed. This

analysis selected the Department of Visual Design in the Faculty of Design in 2020. Among 35 regular and extracurricular programs, a list of programs with statistically significant and quantitative function coefficients was derived and analyzed to determine what kind of effect can be derived when completing the linked course. The function coefficient is a coefficient in the form of  $a_i$  in Equation (1), and it is the weight that each program completion  $X_i$  has on employment  $Y$ .

$$Y = a_0 + a_1X_1 + a_1X_1 + a_1X_1 + \dots + a_iX_i \quad (1)$$

Table 6 results from multiple regression analysis on completing the regular curriculum, extracurricular programs, and employment status. Psychological counseling programs, limited personality competency liberal arts courses, self-diagnosis and employment planning, and employment and entrepreneurship career counseling were in order of high quantitative relationship. In other words, the weight may be different for each curriculum and program. However, it is possible to derive a list of programs that have a positive impact so that results can reflect meaningful programs when deriving the department's curriculum. In addition, when logistic regression analysis is performed, how much synergy effect between several programs could be derived by calculating the odds ratio (Equation (2)), which is the probability of employment ( $p$ ) and the probability of not being employed ( $1-p$ ) when completing multiple programs continuously. In the case of the corresponding department, the odds ratio increased by about 1.04 times when the psychological counseling program and career counseling program were completed in conjunction with the odds ratio when only the psychological counseling program was completed. As a result, a result that can be used to check whether the curriculum for completion

of education by grade initially established in each department can exert a mutual synergy effect was derived.

$$odds(p) = \frac{P}{1-p} \quad (2)$$

### **Qualitative analysis between competency achievement and employment status related to core competency enhancement**

Correlation and clustering analysis were performed between the independent variable, academic achievement and competency achievement, and the dependent variable, employment place review score. In designing major education based on competency-based education, it is necessary to analyze the department curriculum trends regarding vocational education. Three types were derived from arranging the distribution and correlation analysis of the academic achievement score and the place of employment review score by selecting only the employed among the graduating students.

- Weak quantitative relationship: departments that require a deep major understanding of job performance

- Almost Negligible Relations: Departments with active on-demand education

- Unavailable for analysis: Departments related to industries with a small number of employed persons or relatively few databases of employment review scores

In Figure 3, the Department of Mechanical Engineering in the Faculty of Engineering has a weak quantitative relationship between the competency achievement score and the place of employment review score. In the case of the relevant department, it is necessary to operate courses that can equip students with job expertise, as facilitating major education positively affects students' ability to enter high-



quality employment. The remaining Almost Negligible Relations departments require course operation that links various industries, job discovery, and curriculum. In the case of the Unavailable for analysis, it is necessary to develop a tool to evaluate it, as the database for the qualitative status of employment is insufficient.

Second, as a result of analyzing the correlation between the competency achievement obtained by completing the major, liberal arts, and extracurricular programs for each core competency of the university and the job place review score, the competencies that positively affect the quality of the place of employment were derived differently for each department. Table 7 results from deriving competency fields with a quantitatively significant relationship by analyzing the correlation between competency achievement and student review scores in representative engineering and management service departments. Regarding the details, in the case of the Department of Mechanical Engineering, the quality of students' employment places improves when the vocational basics and the employment and start-up competencies are strengthened.

In the case of the Department of Airline Management-Airline Management Major, it was found that if students focus on character and basic learning competencies, they can enter a better place of employment. Based on this result, departments need to guide all students to complete regular curriculum and extracurricular programs related to core competencies in each department if they aim to find an excellent job without considering the characteristics of students.

Finally, after clustering analysis was performed based on the competency achievement of students in the department, learning support analysis was performed based on differences in each cluster. Data similarity was measured and divided into clusters based on the distribution of competency achievement. Then, learners were classified into three clusters to analyze the

differences between the clusters. The subject department was a representative department of the engineering department defined above. The analysis was divided into three groups: excellent, intermediate, and poor. Table 8 shows the distribution of students in each cluster. Among the three groups, Clu0, Clu1, and Clu2 represent poor, medium, and excellent learners, respectively, and it can be seen that the poor group has the largest size and the excellent learner has the smallest size. At this time, if you check the difference between excellent-intermediate and middle-underperforming learners, it can be confirmed that excellent learners have a relatively higher distribution of the vocational basics and the employment and start-up competencies than intermediate learners, and intermediate learners have a higher distribution of the basic learning and the job performance competencies than poor learners. There is a high distribution of job performance competency. A linkage analysis of this result and the previous results shows that it is the same fact that students in the relevant department need to strengthen their vocational basics and employment and start-up competencies to improve the quality of employment. It can be confirmed that the job performance capability, the major learning, should be facilitated for the poor learner. In order to verify the validity of the short conclusion derived, the cluster distribution of excellent, intermediate, and underperforming learners was checked based on employment and start-up competency (Fig. 4). There is a difference in the review score of the place of employment. In addition, the center of the basic competency in starting a job for underachieved and intermediate learners was the same. Since this difference cannot be regarded as a difference in the qualitative score of the place of employment, strengthening other competencies can be analyzed as the difference in the result. Through this, when guiding students in the department, based on the distribution of the student's competency achievement, comparing the difference with the

competency achievement that the department's students should have, if the competency area that the student needs to be strengthened is derived, it is more likely that the student's quality employment and can be linked.

## **CONCLUSIONS**

This study presented an analysis method for regular and program operation optimized for higher vocational education and participation plans by analyzing the relationship between competency-based education and employment outcomes at Y University.

In the analysis of the core competency enhancement rate and employment status by year, the correlation between the education certification rate and the employment rate at the department level from 2017 to 2019 was analyzed, and a clear quantitative correlation was derived between the education certification rate and the employment rate from 2018 to 2019. As a result of reexamining the employment rate of those who completed the program, field practice, capstone design, and basic learning competency diagnosis and reinforcement programs were identified as core subjects and programs at the university level. However, in the correlation analysis using the department-level TRUST education certification rate and the employment rate by the department in 2020, the standard correlation index and significance level were not satisfied. As the breaking phenomenon occurred, it was possible to conclude that preparing an efficient operating model in which face-to-face and non-face-to-face education can coexist was necessary.

In the quantitative analysis between participation in regular courses and programs related to strengthening core competencies and employment status, excellent programs that positively affect employment by the department were derived through 1:1 matching and correlation analysis between regu-

lar courses and extracurricular programs and employment. A primary method for deriving a roadmap with a high linkage effect was presented through multiple regression and logistic regression analyses between participation in extracurricular programs and employment status. However, since the analysis is based on simple participation and employment status, an in-depth analysis of continuous data such as competency achievement, certification scores, and employment status is needed.

In the qualitative analysis between competency achievement and employment status related to core competency enhancement, the mechanism of major learning's influence on employment was derived through the linkage analysis between the average student's major score by the department and the review score of the place of employment. Three types of trends were derived, and the characteristics of each trend were In consideration of this, the necessary measures to lead major education were presented. In addition, through a linkage analysis between student competency achievement by the department and qualitative status variables (review scores) at the place of employment, core competency areas related to employment qualitative improvement were derived, and through cluster analysis, differences between excellent, intermediate, and under-performing learners and focus competency enhancement areas for growth By deriving, a method for realizing student-customized education in the department was suggested.

Through this preliminary analysis, in the future, multiple regression analysis using standardized competency achievement and certification scores for each regular course and extracurricular program, deriving weights for each program, and preparing a plan for qualitative growth in employment through analysis of sub-competent achievement within competency achievement can be conducted, and the university's staff can plan to seek practical application

methods through advanced analysis of educational data, that which programs should be taken for each student considering their current' competency achievement by comparing the high-level student's score or the average score of the department that the student is belonging.

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## APPENDICES

**Table 1**  
*Y-university core competency definition*

Core competence	Definition	Sub competence
Character	Character competencies that combine the philosophy of university establishment, the ideal of human resources, and the spirit of collaboration, creativity, trust, and challenge required by the industry	Creative
		Cooperation
		Trust
		Challenge
Basic learning	Essential learning competencies required to complete the university curriculum	Language
		Mathematics
		Thinking power
Vocational Basics	Seven essential competencies required for successful job performance in Common	Communication
		Human relationship
		Emotional intelligence
		Complex problem solving
		Resource management
		Use of knowledge information
Job Performance	Competencies that can be applied to fieldwork through knowledge and skills related to the major	IT
		Major
Employment & start-up	Employment mindset competencies required for employment and preparatory competencies required for entrepreneurship	Employment
		Start-up

**Table 2**  
*Data analysis*

Student data	Division	Size (Student #N row ×; Data column)
School register and academic information (Admission~Graduation)	2018.02	1,911×1
	2019.02	1,729×1
	2020.02	1,984×1



	2021.02	1,762×1
Participation data of regular and extracurricular programs (The last enrolled year)	2017	1,911×17
	2018	1,729×15
	2019	1,984×17
	2020	1,762×35
Competency Point Average (Admission~Graduation)	2018.02	1,911×5
	2019.02	1,729×5
	2020.02	1,984×5
	2021.02	1,762×5
Grade Point Average (Year of graduation)	2018.02	1,911×1
	2019.02	1,729×1
	2020.02	1,984×1
	2021.02	1,762×1
Employment Status, Company, Company's review points (After graduation)	2018.02	1,911×3
	2019.02	1,729×3
	2020.02	1,984×3
	2021.02	1,762×3

**Table 3**  
*Independent variables*

Student	Participation data of regular and extracurricular programs											Grade point average (GPA)	
	Character		Basic learning		Vocational Basics		Job Performance		Employment & start-up		Competency point average (CPA)		CPA certification
	<i>a</i>	<i>b</i>	<i>d</i>	<i>e</i>	<i>g</i>	<i>h</i>	<i>j</i>	<i>k</i>	<i>m</i>	<i>n</i>			
$S_1$	O	X	X	X	X	X	X	X	X	X	300	X	3
$S_2$	O	X	X	X	O	O	X	X	X	X	400	O	2.5
$S_3$	O	X	O	X	X	O	O	O	O	X	41	O	4.1
$S_4$	X	X	X	O	O	X	X	O	O	O	500	O	4.5
$S_5$	O	O	O	O	O	O	O	O	O	O	510	O	3.5
$S_6$	O	X	X	X	X	X	X	X	X	X	305	X	3.8
$S_7$	O	O	O	O	O	O	O	O	O	O	200	O	3.7
$S_8$	O	O	O	X	X	X	X	X	X	O	150	X	3.4
:	:	:	:	:	:	:	:	:	:	:	:	:	:
$S_{N-1}$	O	O	O	O	X	X	X	X	X	X	550	O	1.2
$S_N$	X	X	X	X	X	X	X	X	X	X	0	X	4.5

**Table 4**  
*Dependent variable*

Student	Employment status		
	Employment	Company	Company's review point
$S_1$	X	-	0
$S_2$	O	A	4.2
$S_3$	O	B	3.0
$S_4$	O	C	1.2
$S_5$	X	-	0
$S_6$	O	A	4.2
$S_7$	X	-	0
$S_8$	:	:	:
:	X	-	0
$S_{N-1}$	O	D	0
$S_N$	X	-	0

**Table 5**  
*The correlation analysis between education participation and employment status*

Core competence	Regular Curriculum and Extracurricular Programs		
	Face-to-face class (2017~2019)	Related faculties and departments	Non face-to-face class (2020)
Character	Curriculum of liberal arts	-	Faculty of Engineering (Information and communication), Faculty of Design (Visual Design) Faculty of Business Administration (Advertising & Media Management Major)
	Psychological counselling	Faculty of Health and Lifestyle (Child care)	Faculty of Design (Visual Design)
	Special Lecture on Entrepreneurship - 'noblesse oblige'	Faculty of Design (Animation)	-
Basic learning	-	-	-
Vocational Basics	Curriculum of liberal arts	Faculty of Design (Industrial design, Interior Architecture)	Faculty of Engineering (Building Systems & Fire protection)
Job Performance	Field practice	Faculty of Engineering	Faculty of Engineering (Mechanical Engineering)

	(Electronic Engineering, Building Systems & Fire protection, IT Business)	Faculty of Design (Animation) Faculty of Business Administration (Management-Distribution Management Major)
	Faculty of Design (Fashion Design) Faculty of Business Administration (Global Hotel & Airline Management-Japan Business Major, Management-Distribution Management Major)	
Capstone design	Faculty of Health and Lifestyle (Industrial & Health)	Faculty of Engineering (Electrical Engineering, Automation Engineering, VR Game & App)
Project based learning with industry mentoring	Faculty of Health and Lifestyle (Food & Nutrition)	-
National Qualification Acquisition Program	-	Faculty of Engineering (Mechanical Design) Faculty of Business Administration (Global Hotel & Airline Management-Japan Business Major & Chinese Business Major, Management-Tax & Accounting Major)
Employment & start-up	Employment/startup-career counselling	Faculty of Engineering (Computer Science & Engineering)
	Self-diagnosis and employment planning	- Faculty of Engineering (Computer Science & Engineering)
	Non formal extra-curricular program	Faculty of Design (Animation) Faculty of Business Administration (Management-Distribution Management Major)

**Table 6**

*The multiple linear regression analysis between education participation and employment status in the case of the Department of Visual Design in the Faculty of Design*

Core competence	Regular Curriculum and Extracurricular Programs	Education participation and employment status	
		multiple linear regression analysis	
		Regression coefficient	<i>p</i> -value
Character	Curriculum of liberal arts	0.4012*	0.030*
	Psychological counselling	0.8983*	0.001*
Vocational Basics	Curriculum of liberal arts	-0.2664	0.103
	National certifications regarding language	0.2702	0.577
Job Performance	Capstone design	-0.0369	0.808
Employment & start-up	Employment/startup career counselling	0.1859*	0.000*
	Self-diagnosis and employment planning	0.1959*	0.000*

**Table 7**

*The correlation analysis between the CPA and company's review point in case of the department of mechanical engineering and the department of Global Hotel & Airline Management-Airline Management Major*

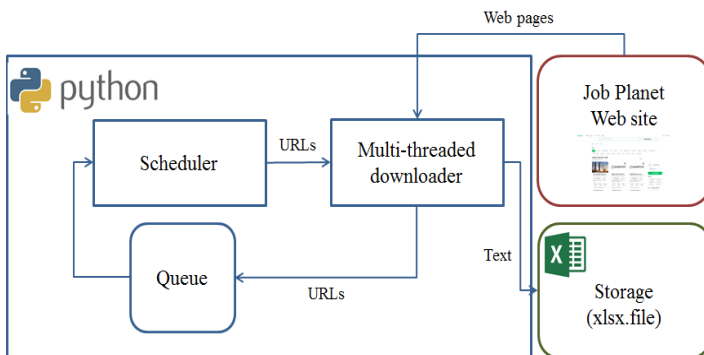
(1) Department of mechanical engineering		
Core competence	CPA and company's review point	
	Correlation coefficient	<i>p</i> -value
Character	0.2335	0.1526
Basic learning	-0.0063	0.9697
Vocational Basics	0.3435*	0.0323*
Job Performance	0.0247	0.8812
Employment & start-up	0.472*	0.0024*
(2) Department of Global Hotel & Airline Management-Airline Management Major		
Core competence	CPA and company's review point	
	Correlation coefficient	<i>p</i> -value
Character	0.8260*	0.0428*

Basic learning	0.8357*	0.0383*
Vocational Basics	-0.0730	0.0992
Job Performance	0.1871	0.7227
Employment & start-up	0.2373	0.6508

**Table 8**  
*The K-means clustering analysis of 5 Competency Point Average (CPA) into a set of k groups in case of the department of mechanical engineering*

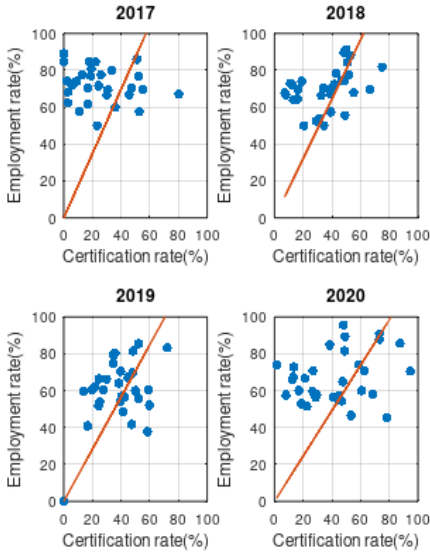
Core competence	K-means clustering analysis		
	Clu0	Clu1	Clu2
Character	8.8158	19.3611	34.0909
Basic learning	0	73.2394	71.5818
Vocational Basics	46.275	57.3922	78.7855
Job Performance	54.0137	90.7958	92.7136
Employment & start-up	30.7895	36.6667	110.9091
Count	38	36	22

**Figure 1**  
*Acquisition of company's review scores using web crawling*



**Figure 2**

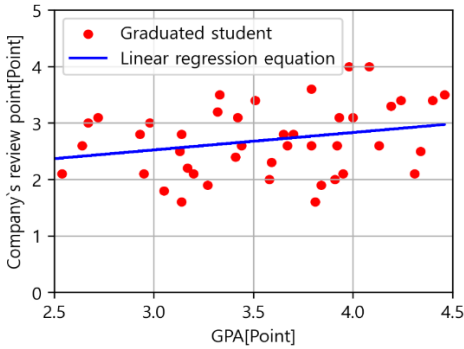
*The correlation analysis between the certification rate and employment rate in the case of every department*



Certification rate and employment rate		
Pearson correlation analysis		
Year	Correlation coefficient	<i>p</i> -value
2017	-0.1748	0.3556
2018	0.4030	0.0272*
2019	0.4113	0.0240*
2020	0.2440	0.1783

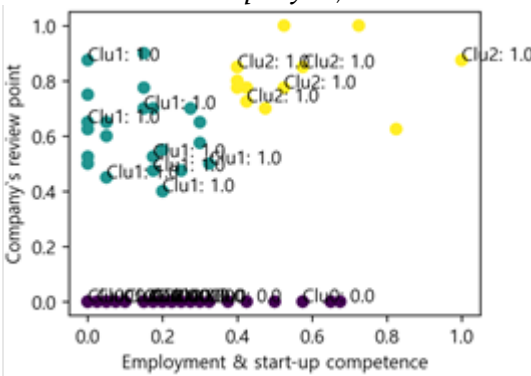
**Figure 3**

*The correlation analysis between GPA and company's review point in case of the department of mechanical engineering in the faculty of engineering*



**Figure 4**

*The K-means clustering analysis regarding Employment & Start-up competence into a set of k groups in the case of the department of mechanical engineering (Clu# = 1: Employed, Clu# = 0: Not employed)*



### Acknowledgments

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