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Differences in Core Competencies and Longitudinal Changes Among Undergraduate Students: A Case Study on K-CESA

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Abstract: The purpose of this study is to analyze the results of K-CESA diagnosis of undergraduate students in order to verify the changes in core competencies by year and the difference in core competencies by students' majors. To this end, the researchers analyzed the differences in students' core competencies by department and trends by year by extracting the data from the students who participated in the K-CESA survey conducted by P University, a four-year university located in D City, in both 2019 and 2020. The results revealed that students' global competency improved as compared to the first year in the second year examination, while the overall thinking and communication capacity decreased. In addition, while engineering departments were found to be superior to other departments in their ability to use resource information technology, leadership competency in interpersonal relations was low, and the global competency of social students was high. Based on the results, the impact of non-face-to-face classes due to COVID-19 on the core competencies of university students and the ways to improve the curriculum to close the gap in the level of core competencies by students' majors were discussed.

Keywords: Core Competencies, Undergraduate Students, Differences in Core Competencies, Longitudinal Changes, K-CESA

1. Introduction

In recent years, with the growth of importance of educational accountability of universities, the need to objectively diagnose and confirm the effectiveness of university education activities has increased. In addition, the government's policy for university financial support projects is important to manage data-based education quality. This is linked to the flow of Big Data-based value creation, which has been actively discussed in various fields of society in recent years, and its validity is further emphasized[1].

One of the educational outcome indicators that are important in the data-based education quality management of universities is "core competency". Core competency is defined as "a core component of vocational competency and refers to the knowledge, skills, attitudes, etc. that are commonly required to perform a job successfully in most occupations regardless of job type or position"[2].

Traditionally, university education has aimed to raise professionals and complete job performance. However, recent research has revealed limitations of university education in terms of predicting the success of work and life after graduation. Accordingly, capacity development has become an important

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performance indicator of university education[3]. In this context, each university seeks to demonstrate that it fully provides students with core competencies required by the current knowledge-based society. Accordingly, evaluation tools that reflect the characteristics of each country are being developed to evaluate these core competencies. A representative tool for diagnosing the core competencies of university students is the university student core competency diagnosis tool (K-CESA). This tool, developed by the Korea Research Institute for Vocational Education and Training, has been supervised by the Institute since 2010. The K-CESA is the only standardized diagnostic tool in Korea that diagnoses six core competencies essential for achieving achievement in the professional world for college students[4]. In terms of its scope, the K-CESA consists of communication competency, resource information technology utilization competency, comprehensive thinking ability, global competency, local competency and self-management competency, and interpersonal relationship competency. In the K-CESA, the utilization capacity of resource information technology, which is the center of data analysis, is included instead of the global capacity and mathematical capacity that reflects Korea's industrial characteristics[2]. Universities participating in the K-CESA diagnosis seek to establish an education system based on the core competencies of the university based on the diagnosis results. The participating universities aim not only to improve the curriculum, but also to use the diagnosis results as student career data by linking various data related to students[5].

In order to improve university education and develop students' career paths and careers, with a particular focus on core competencies, it is important to understand the relationship between students' individual characteristics and core competencies[6]. Accordingly, many previous studies related to the K-CESA have investigated the differences caused by students' individual variables[7-9], as well as the effects of other variables, such as learning capability, creative fusion capability, and satisfaction[10], [3][9]. However, relevant research on the relationship between the K-CESA test results and additional variables remains scarce[5]. Above all, in order to accurately analyze changes in students' core competencies through the achievements of university education, it is necessary to not only analyze the relationship between variables, but also to conduct repeated tests and longitudinal studies[11]. During the COVID-19 crisis, most university classes in 2020 were non-face-to-face, so the impact of such classes on the quality of university education can be confirmed through a comparative analysis of 2020 data with the data from previous years.

Accordingly, the present study is aimed to analyze the changes in students' core competencies by year and the differences in core competencies by students' majors. The research questions are follows. First, how is the change in the core competency of university students over the year? Second, what is the differences in core competencies by students' majors? To this end, we used the results of the K-CESA diagnosis conducted by P University, a local private university. The paper concludes with a discussion of the direction of improving the curriculum using the results of competency diagnosis.

2. Contents

2.1 Study Method

In this study, the differences in students' core competencies by department and trends by year were analyzed by extracting the data from the students who participated in the K-CESA survey conducted by P University, a four-year university located in D City, in both 2019 and 2020. The general characteristics of participants are summarized in [Table 1].

The first year examination was applied in October 2019 and conducted over two weeks on November 6-18; the participants participated in the briefing session in advance to confirm the purpose, contents, and method of the examination. The 2nd year examination was applied in October 2020 and was conducted over 3 weeks on November 2-20; this examination was also conducted after informing

the participants about the purpose, contents, and method of the examination in advance. A total of 360 participants took the first year's test, while a total of 390 participants answered the second year's test. Among them, 116 students participated in both the first and second years of the survey, and their data were used in this study.

[Table 1] Participant Characteristics

Category		n	%
Gender	Male	47	40.5
	Female	69	59.5
	total	116	100.0
Grade	1	40	34.5
	2	37	31.9
	3	37	31.9
	4	2	1.7
	Total	116	100.0
Major	Humanities	35	30.2
	Social Science	13	11.2
	Natural Science	16	13.8
	Engineering	28	24.1
	Art & Sports	24	20.7
	Total	116	100.0

Using the annual trend analysis, we analyzed the average difference through the response sample T-test by converting the diagnosis results of the participants' six core competencies as measured by the K-CESA in both 2019 and 2020 K-CESA to T-score. In order to find out the differences in core competencies of each group of students participating in the K-CESA in 2020, six core competency diagnosis results were converted to T scores, and a two-way ANOVA was conducted to analyze the differences. For the post-analysis of each core competency, the homogeneity of variance was assumed to be equal variance ($p>.05$), and the post-analysis was run by adopting LSD as a multiple comparison test method.

2.2 Results

2.2.1 Analyze Changes in Overall Competency Score

For the students who participated in both the K-CESA surveys in 2019 and 2020, the results of the K-CESA's six core competency diagnosis were converted to T-scores, and the differences in average scores were analyzed. The results showed that the T-score of 'global competence' improved from the average of 48.31±10.22 in 2019 to 50.67±12.58 in 2020, and this change was statistically significant ($t=-0.072$, $p=.041$). The 'comprehensive thinking' score decreased from the average of 45.82±12.90 in 2019 to 39.26±18.98 in 2020 and was statistically significant ($t=4.201$, $p=.000$). Self-management and interpersonal competencies were higher in 2020 than in 2019, but were not statistically significant. The utilization of resource information technology and communication were lower in the second year than in the first year, but the different did not reach statistical significance. The results of the K-CESA's annual average score are reported in [Table 2].

[Table 2] Average Change in T Scores for the K-CESA (N=116)

Core competency	2019		2020		t	p
	M	SD	M	SD		
Self-management	50.17	11.53	49.83	12.32	0.401	.689
Interpersonal relationship	54.78	11.28	54.99	11.88	-0.230	.819
Utilization of resource information technology	46.43	7.03	45.73	8.05	0.954	.342
Global	48.31	10.22	50.67	12.58	-2.072	.041*
Communication	39.60	11.11	37.64	11.84	1.927	.056
Comprehensive thinking	45.82	12.90	39.26	18.98	4.201	.000*

* p<.05

2.2.2 Analysis of Changes by Competence

2.2.2.1 Self-management

Among the six core competencies of the K-CESA, the T score for 'self-management' was slightly lower from the average of 50.17±11.53 in 2019 to 49.83±12.32 in 2020, but the difference was not statistically significant (t=0.401, *p*=.689). The four sub-competencies (‘self-directed learning ability’, ‘emotional self-regulation’, ‘goal-oriented planning and execution ability’, and ‘occupational awareness’) all showed slight decreases in average scores, but were not statistically significant (*p*>.050).

2.2.2.2 Interpersonal Relationship

Among the six core competencies of the K-CESA, the 'interpersonal' T score slightly increased from the average of 54.78±11.28 in 2019 to 54.99±11.88 in 2020, but was not statistically significant (t=-0.230, *p*=).819). Among the five sub-competencies of the K-CESA's core competencies—namely, 'emotional ties', 'cooperation,' and 'leadership' showed slightly increased, while 'intervention' and 'understanding of the organization' scores were insignificant, but not statistically significant (*p*>.05).

2.2.2.3 Utilization of Resource Information Technology

The T-score of 'utilization of resource information technology' slightly reduced from 46.43±7.03 in 2019 to 45.73±8.05 in 2020, but the change was not statistically significant (t=0.954, *p*=.342). The scores of the three lower competencies—namely, 'resource utilization capacity', 'information utilization capacity,' and 'technology utilization capacity,'—slightly decreased, but were not statistically significant (*p*>.050).

2.2.2.4 Global

The T score of 'global competency' improved from the average of 48.31±10.22 in 2019 to 50.67±12.58 in 2020, and this change was statistically significant (t=-0.072, *p*=.041). Although the 'flexibility' of the three lower competencies slightly decreased, the change did not reach statistical significance (*p*<.05); in contrast, 'understanding and acceptance of other cultures' showed a statistically significant increase (t=-3.683, *p*<.001). The score of 'globalization and understanding the global economy' slightly increased, but the change was not statistically significant (*p*>.050).

2.2.2.5 Communication

The T-score of 'communication' was slightly reduced from 39.60±11.11 in 2019 to 37.64±11.84 in

2020, but the change was not statistically significant (t=1.927, *p*=.056). Among the five sub-talents, ‘listening ability’, ‘discussion coordination ability’, ‘writing ability’, and ‘speech ability’ somewhat decreased, but the decrease was not significant (*p*>.050). However, the reading capability statistically significantly decreased from the average of 46.68±11.99 in 2019 to 42.43±15.77 in 2020 (t=2.567, *p*=.012).

2.2.2.6 Comprehensive Thinking

The T-score of 'comprehensive thinking competence' was statistically significantly reduced from the average of 45.82±12.90 in 2019 to 39.26±18.98 in 2020 (t=4.201, *p*=.000). Among the four lower competencies, the average score of 'analysis ability' decreased in 2020 as compared to 2019, although the difference did not reach statistical significance (*p*=.05) 'Estimated Capacity' was statistically significantly reduced from the average of 44.41±13.57 points in 2019 to 39.60±17.24 points in 2020 (t=2.807, *p*=.006). 'Evaluation capability' was statistically significantly reduced from the average of 46.59±13.34 points in 2019 to 38.71±19.62 points in 2020 (t=4.787, *p*<.001). The 'alternative capability' was statistically significantly reduced from the average of 43.97±15.95 in 2019 to 21.00±21.00 in 2020 (t=4.269, *p*<.001).

2.2.3 Trend Analysis of Core Competency Changes by Students′ Major

The scores of the participants who repeatedly participated in the K-CESA diagnostic tests in 2019 and 2020 were converted into T-scores of 6 core competency diagnosis results for each major. The results of our analysis of the changes in annual trends are summarized in [Table 3].

[Table 3] Analysis of T-Score Change in the K-CESA by Students’ Major (2019-2020)

Core competency	Major	N(%)	2019		2020		t	p
			M	SD	M	SD		
Self-management	Humanities	35(30,2)	52.13	12.42	▽50.67	13.57	0.922	.361
	Social Science	13(11.2)	50.37	11.23	△52.95	13.66	-0.838	.420
	Natural Science	16(13.8)	48.48	11.54	△50.44	12.61	1-070	.320
	Engineering	28(24.1)	47.45	9.43	△47.53	11.06	-0.062	.951
	Art & Sports	24(20.7)	50.23	12.40	▽49.22	10.96	0.557	.583
	Total	116(100)	50.17	11.53	▽49.83	12.32	0.401	.639
Interpersonal relationship	Humanities	35(30,2)	57.53	10.72	▽56.47	11.67	0.676	.503
	Social Science	13(11.2)	52.92	14.73	△57.78	13.25	-1.384	.194
	Natural Science	16(13.8)	51.60	8.91	△53.26	10.67	-1.219	.262
	Engineering	28(24.1)	51.90	9.18	△51.99	11.02	-0.070	.945
	Art & Sports	24(20.7)	55.10	12.80	▽54.97	13.04	0.055	.957
	Total	116(100)	54.78	11.28	△54.99	11.88	-0.230	.819
Utilization of resource information technology	Humanities	35(30,2)	46.05	6.72	▽44.30	6.90	1.488	.144
	Social Science	13(11.2)	45.17	7.83	▽44.00	7.86	1.103	.294
	Natural Science	16(13.8)	50.88	5.51	△52.63	10.57	-0.494	.636
	Engineering	28(24.1)	46.89	5.12	△47.86	8.11	-0.771	.447

	Art & Sports	24(20.7)	45.75	9.19	▽44.46	8.04	0.632	.534
	Total	116(100)	46.43	7.03	▽45.73	8.05	0.954	.342
Global	Humanities	35(30,2)	47.78	9.43	△50.93	12.86	-1.771	.084
	Social Science	13(11.2)	45.94	7.41	▲55.17	11.95	-2.744*	.019
	Natural Science	16(13.8)	48.82	10.77	▽47.43	11.79	0.510	.625
	Engineering	28(24.1)	47.29	11.53	△48.18	13.10	-0.349	.730
	Art & Sports	24(20.7)	51.48	11.10	△51.94	12.09	-0.177	.861
	Total	116(100)	48.31	10.22	▲50.67	12.58	-2.072*	.041
Communication	Humanities	35(30,2)	39.98	11.62	▽38.05	13.50	1.028	.310
	Social Science	13(11.2)	38.08	12.41	△40.00	10.00	-0.751	.469
	Natural Science	16(13.8)	42.25	14.34	△44.75	9.41	-0.528	.614
	Engineering	28(24.1)	39.29	10.25	▽36.29	10.50	1.574	.127
	Art & Sports	24(20.7)	39.17	10.04	▼34.92	11.17	2.329*	.029
	Total	116(100)	39.60	11.11	▽37.64	11.84	1.927	.056
Comprehensive thinking	Humanities	35(30,2)	47.11	11.37	▼38.02	19.09	3.399**	.001
	Social Science	13(11.2)	47.83	9.14	▽40.00	17.33	1.587	.141
	Natural Science	16(13.8)	47.13	13.14	▽39.25	26.67	0.844	.427
	Engineering	28(24.1)	47.54	7.36	▽42.50	17.53	1.717	.097
	Art & Sports	24(20.7)	40.00	19.74	▽37.38	19.47	1.020	.318
	Total	116(100)	45.82	12.90	▼39.26	18.98	4.201***	.000

▲: Statistically significant improvement △: Statistically non-significant improvement

▼:Statistically significant degradation ▽:Statistically non-significant degradation

* p<.05, ** p<.01, *** p<.001

Of the six core competencies of the K-CESA, the areas that showed statistically significant changes over the year were 'global' and 'comprehensive thinking' competencies. In what follows, we will briefly review meaningful trend changes in each major. Among the core competencies of the K-CESA in the social sector, the 'global' competency score statistically significantly improved in 2020 (55.17±11.95 points) as compared to 2019 (45.94±7.41 points)(t=-2.744, p=.019).

The average values of the three sub-competencies of 'flexibility', 'understanding and acceptance of other cultures' and 'globalization and understanding of the global economy' all showed a growing trend; however, the change was statistically significant only for 'understanding and acceptance of other cultures' (t=-2.679, p=.021). Of note, among the three lower competency scores within the 'global' core competency, the 'other culture understanding and acceptance' score, which was the lowest in 2019, rose to the top in 2020.

Among the core competencies of the K-CESA in humanities, the 'comprehensive thinking' competency was statistically significantly reduced in 2020 (38.02±19.09) as compared to 2019 (47.11±11.37 points)(t=3.399, p=.001). The average score of all four sub- competencies (analysis, inference evaluation, alternative) decreased in 2020 as compared to 2019, with all three sub-competencies, except for 'inference competence' (p<.050), showing a statistically significant increase.

2.2.4 Analysis of Core Competency Differences by Major Field

The results regarding the differences in the average of the K-CESA's T score by major are

summarized in [Table 4].

[Table 4] Difference in the Average of the K-CESA's T Score by Major (N=116)

Major	Humanities	Social Science	Natural Science	Engineering	Art & Sports	F(p)
N(%)	35(30.2%)	13(11.2%)	16(13.8%)	28(24.1%)	24(20.7%)	
Self-management	50.67	52.95	50.44	47.53	49.22	.497(.738)
Interpersonal relationship	56.47	57.78	53.26	51.99	54.97	.818(.516)
Utilization of resource information technology	44.30	44.00	52.63	47.86	44.46	2.755*(.031)
Global	50.93	55.17	47.43	48.18	51.94	.852(.495)
Communication	38.05	40.00	44.75	36.29	34.92	1.275(.284)
Comprehensive thinking	38.02	40.00	39.25	42.50	37.38	.307(.873)

* p<.05

2.2.4.1 Self-management

The T-score average for self-management was the highest, with 52.95 points for social science, followed by Humanities (m=50.67), Natural Sciences (m=50.44), Art and Sports (m=49.22), and Engineering (m=47.53); however, none of these changes were statistically significant (F=0.497, *p*=.738).

2.2.4.2 Interpersonal Relationship

The T-score average for interpersonal competency was the highest with 57.78 for Social Science, followed by Humanities (m=56.47), Art and Sports (m=54.97), Natural Sciences (m=53.26), and Engineering (m=51.99); yet, this difference was not statistically significant (F=0.818, *p*=.516). The results of post-analysis verification revealed that the lower competence of the T-score average for each family was 'leadership', with Engineering (m=48.53) statistically significantly lower than Social Sciences (m=57.38) and Art and Sports (m=54.94)(*p*<.05).

2.2.4.3 Utilization of Resource Information Technology

The T-score average for the utilization of resource information technology was the highest, with 52.63 for Natural Science, followed by Engineering (m=47.86), Art and Sports (m=44.46), Humanities (m=44.30), and Social Science (m=44.00)(F=2.755, *p*=.031). After checking the assumption of equivariance (p>.05) in post-analysis, the LSD was adopted and verified by multiple comparison test methods, and the natural science class was found to be significantly higher than other majors (*p*<.05).

Among the lower competencies, the T-score average for ‘technology utilization capacity’ was shown in Natural Science (m=52.00), Engineering (m=50.39), Social Science (m=45.50), Humanities (m=43.80), and Art and Sports (m=42.79). These differences were statistically significant (F=2.652, *p*=.037). Furthermore, the result of the post-hoc analysis showed that the 'skill utilization' in Art and Sports was statistically significantly lower than that of Natural Science and Engineering (*p*<.050), and 'technology utilization capacity' in Engineering was significantly higher than in Humanities (*p*<.050).

2.2.4.4 Global

The T-score average of global competence was the highest, with 55.17 for Social Science, followed by Art and Sports (m=51.94), Humanities (m=50.93), Engineering (m=48.18), and Natural Sciences

(m=47.43), but this difference was not statistically significant (F=0.852, *p*=.495). After checking the assumption of equivariance (p>.05) for post-analysis, the difference was not to be not statistically significant (*p*>.05).

2.2.4.5 Communication

The T-score average for communication skills was the highest, with 44.75 for Natural Science, followed by Social Science (m=40.00), Humanities (m=38.05), Engineering (m=36.29), and Art and Sports (m=34.92); however, this difference was not statistically significant. (F=1.275, p=.284). Yet, after checking the assumption of equivariance (p>.05) for post-analysis, the T score of 'communication' was partially statistically significant as a result of the LSD adoption and verification, the scores of students majoring in Natural Sciences were significantly higher than those of students majoring in Art and Sports (p=.043).

2.2.4.6 Comprehensive Thinking

The T-score average of the overall thinking competence was the highest, with 42.50 points in Engineering, followed by Social Science (m=40.00), Natural Science (m=39.25), Humanities (m=38.02), and Art and Sports (m=37.38); however, this difference was not statistically significant (F=0.307, p=.873).

3. Discussion and Conclusions

This study aimed to analyze changes and differences in core competencies by students' majors using the diagnosis results of duplicate participants in 2019 and 2020 of the K-CESA test, a diagnostic tool for university students' core competencies.

First, the results of the analysis of the longitudinal core competency changes revealed that the global competency among the six core competencies showed statistically significantly improvements, while comprehensive thinking and communication competency decreased. Specifically, while 'flexibility' competency among global competencies decreased, 'globalization and global economic understanding' and 'intercultural understanding and acceptance capacity' significantly improved. In the comprehensive thinking ability, the 'reasoning ability', 'evaluation ability', and 'alternative ability' all significantly decreased. Furthermore, in terms of communication competency, the 'reading ability' significantly decreased.

The abovementioned results are consistent with the results of the KRIVET (2019) which showed that the higher the grade, the higher the global competency score, and Hwang Ji-won (2019) found that the global competency score of early childhood education and students significantly improved in the second year. At present, P University invests much effort into strengthening its global competency by classifying liberal arts education courses as "core basic education, convergence education, practical practice education, and global customized education" and establishing a global talent training system. Kim Eun-joo (2019) emphasized the importance of operating and organizing core competency-based liberal arts curriculum for the improvement of core competences of university students by analyzing the changes in K-CESA core competency according to the operation of the liberal arts curriculum. Said differently, the students' global competence improvement in the results of this study can be seen to highlight the effectiveness of competency-based liberal arts and comparison programs run by universities. On the other hand, we found a decrease in the ability to reason, comprehensive thinking skills, evaluation ability, and reading ability among communication skills. These changes were a result of non-face-to-face class operation due to Covid-19. Previous studies have shown that active class attitudes, professor-student interactions, and participation in classes affect the core competencies of university students[12-16], and that non-class activities help to foster students' communication skills

and comprehensive thinking skills[17]. Among these core competencies, the factors that affect comprehensive thinking skills are attitudes, teaching methods, and interactions that are more difficult to perform effectively in non-face-to-face classes than in face-to-face classes. In addition, considering that non-class activities, such as exchange between peers and seniors or club activities, were difficult during the COVID-19 pandemic, it can be inferred that poor participation in non-class activities led to the overall decline in thinking skills.

Second, as suggested by the results of the analysis of the trends in core competency changes in each major, students majoring in Social Science ranked the lowest among the five "global" competency scores in 2019, but the results rose to the top in 2020. Furthermore, the group that showed the biggest change in 'comprehensive thinking' was students in the humanities department, whose average score dropped significantly in 2020 as compared to the previous year.

Third, the analysis of the differences in core competencies of each major revealed that the average of engineering departments in leadership competencies among interpersonal competencies is significantly lower than the corresponding means of students of other majors. On the other hand, among the competencies of utilizing resource information technology, the average of engineering departments was statistically significantly higher. Among global competencies, the average score of students majoring in Social Sciences was the highest in flexibility competence, as well as in understanding and acceptance of other cultures.

These findings are consistent with the results of KRIVET's research in 2019 that showed that the average use of resource information technology was high in engineering, and the global competency was relatively low in natural and artistic categories. Furthermore, Hwang (2018) and Hwang et al. (2017) also showed that students in engineering departments have a higher ability to use resource information technology as compared to students from other departments. In addition Shin, Hwang, and Song (2019) showed that social students have a high average score of global competence.

Our results can be attributed to different contents related to each competency that students usually encounter in their major subjects and activities other than classes due to the nature of the major. Said differently, while in some majors there are many subjects and activities that deal with understanding other cultures or flexibility in social studies due to the nature of the major, students in engineering have little opportunity to participate in global competency activities autonomously due to individualized classes and school-designated courses[18][19].

Our results provide several important implications for the improvement of the university curriculum. First, it is necessary to develop and operate various teaching methods, interactions, and ways to promote learning participation that can improve students' core competencies in non-face-to-face classes. Given that various factors related to class participation affect the improvement of students' core competency, learning performance is not only a result of prior research, but also the result that students experienced non-face-to-face classes for a year and decreased their comprehensive thinking and communication competence. Non-face-to-face classes are a form of classes in which active and cooperative class attitudes, as well as professor-student interactions, become more difficult than in face-to-face classes. At present, higher education policies are promoting the establishment of a digital new normal higher education system, and non-face-to-face classes are expected to continue to expand in the future due to technological and environmental changes, regardless of the end of the current COVID-19 crisis. Therefore, the improvement of the curriculum to boost university students' core competences should be implemented in close consideration of all factors that can increase the effectiveness of non-face-to-face classes.

Second, it is important to promote non-class activities to improve university students' core competencies. As we discussed earlier, Covid-19 is reducing not only non-face-to-face classes, but also extracurricular activities. In a previous study, students' out-of-class activities were found to affect their core competencies, and the low participation in out-of-class activities caused by COVID-19 was

argued to be the cause of the average drop in core competencies. This suggests that, in order to improve university students' core competencies, it is necessary to establish and operate a competency-based system for future major and liberal arts education courses, as well as for non-class activities such as comparison programs.

Third, our results suggest that it is necessary to provide supplementary programs for areas lacking in each major. Specifically, we found statistically significant differences in global and utilization of resource information technology competence among the core competencies, which are consistent with prior research results. In other words, superior and insufficient competencies vary across different majors. Therefore, in order to narrow such competency gaps, a detailed analysis of insufficient competencies should be conducted by each major, and liberal arts and comparative programs to compensate for these gaps should be provided

In summary, the results of the present study that focused on the analysis of longitudinal changes in university students' core competencies and the analysis of major differences among different majors provide meaningful implications for further improvement of university curriculum. The limitations of the present study include the focus on the students from only one university and the analysis of the overall changes. These limitations warrant follow-up large-scale studies focusing on specific changes in university students' core competencies.

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