

# Effects of University Students' Educational Satisfaction on Convergence and Creative Competencies

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## Abstract

The purpose of this study is to understand the effect of individual and educational factors on convergence and creative competencies of university students. In order to achieve the research purpose, educational satisfaction and creativity and convergence capabilities were measured among 1,379 students in 2021, and multiple regression analysis was conducted using the optimization scale method. The findings showed that if educational satisfaction which is an educational factor that can be managed by a university is high, then the influence of individual factors on the convergence and creative competencies can be reduced. In addition, it was found that satisfaction with extra-curriculum did not affect convergence and creative competencies, but satisfaction with liberal arts and major curricula had an effect on convergence and creative competencies. In particular, it was found that satisfaction with the major curriculum had greater influence on convergence competency, and satisfaction with the liberal arts curriculum had greater influence on creative competency. Based on the research results, it is recommended that universities open various liberal arts and major subjects, and maintain a high level of quality according to the students' level. Moreover, liberal arts subjects must be directed towards improving creativity, and major subjects must be focused on improving job performance for employment.

**Keywords:** educational satisfaction, convergence and creative, liberal arts, major curriculum, extra-curriculum

## 1. Introduction

The future society, described as the information age and the era of the 4th industrial revolution, requires future talents with convergence and creative competencies (Lee and Choe, 2014; Hur, 2013; Kim 2020). The Future Vision 2040 Report on Higher Education also presented creative and convergent talents as the talents of the future society. This is because in a rapidly changing society, a convergent approach is essential to understand various and complex problems, and find developmental solutions through creativity in order to produce original output (Plucker and Beghetto, 2004). At the same time, as it has been argued that convergence and creative capabilities could be developed through education (Robinson, 2010), the biggest issue in the 21st century is to foster creative and convergent talents.

Various support projects are also being carried out at the national level, and universities are also setting convergence and creative competencies as core competencies, and striving to cultivate these through changes in curriculum and comparative curriculum. Along with various educational efforts, a number of studies related to the creative and convergence capabilities of university students have also been conducted (Nam and Park, 2021). Studies have been conducted to grasp the level of creative and convergence competencies of university students (Huh and Hwang, 2020; Kim, 2020), and to analyze the relationship between variables (Bae, Ok, and No, 2020). In addition, a study was conducted to develop educational programs and verify its effectiveness on university students' improvement of their creative and convergence capabilities (Jin and Kim, 2017). Previous studies have reported the influence of personal factors such as gender (Cho and Choi, 2019), year level (Nam, Park, and Song, 2016), and major department (Lee and Lee, 2015), as well as educational factors such as teaching method and major education satisfaction (Kim, 2016; Kim, 2021; Park, Jung, Han, Nam and Youn, 2020; Cho and Kim, 2018).

However, these studies have a drawback since they do not accurately determine the influence on students due to the

lack of control measures of students' pre-scores. In fact, there are individual differences in convergence and creative capabilities; as such, it is necessary to control the differences within individuals in order to accurately understand the differences between individuals (Hur and Park, 2021). In addition, it is not possible to provide detailed implications on setting university education policies and strategies since educational factors have not been divided into categories of satisfaction with liberal arts, major, and extra-curriculum courses. In fact, college education is conducted through a combination of liberal arts, major, and extra-curriculum courses with completely different purposes and characteristics; and for this reason, it is necessary to identify the satisfaction of each college education separately (Hur and Ye, 2018; Lee et al., 2020).

Therefore, the purpose of this study is to understand the effect of personal factors including pre-scores of convergence and creative competencies, as well as gender, year level, major department, and educational satisfaction with liberal arts, major, and extra-curriculum courses on convergence and creative competencies. Subsequently, necessary strategies are recommended to improve the convergence and creative capabilities of university students. There are two research questions in this study. The first research question is to determine the level of educational satisfaction and convergence and creative competencies of university students. The second research question is to discover how individual and educational factors, namely, educational satisfaction of liberal arts, major, and extra-curriculum courses, affect convergence and creative competencies of university students.

## 2. Theoretical Background

### 2.1 Concepts of Convergence and Creative Competencies and Improvement Way

Schwab (2016) stated that in order for the 4th industrial revolution society to become a blessing rather than a disaster, people must have the appropriate abilities and capabilities (Schwab, 2016). Future creative confluence competency is being emphasized as the direction for future education (Lee, Back, Lee and Lee, 2018). In other words, university students must have convergence and creative competencies as major players in the future society. From this perspective, convergence and creative capabilities are not exclusive to a few geniuses; rather, these competencies can be developed through education (Cropley, 2016), and universities strive to improve the convergence and creative competencies of university students through liberal arts, major and comparative programs.

#### 2.1.1 Concepts of Convergence Competency and Improvement Way

Davis (1995) defined 'convergence subjects' as subjects in which professors from two or more disciplines or majors collaborate. In the academic world, convergence means creating new knowledge by linking and integrating subdivided academic fields. Ultimately, convergence competency is defined as the ability to create new values by combining two or more different academic knowledge and skills (Oh and Sung, 2013). And the convergence capability of university students is the ability to create new values by combining academic, technical, and engineering knowledge and skills according to the needs of the industry (Huh and Hwang, 2020). Convergence capability, in this sense, is being emphasized as one of the six capabilities required in the 4th industrial revolution society (Lim, Rye and Kim, 2017).

For this reason, each university emphasizes convergence competency and identifies it as the core competency of the university. There are two educational methods to improve convergence competency. The first way is to create an 'integrated subject knowledge' by synthesizing multiple academic fields, and then passing it on to students. Inter-disciplinary and trans-disciplinary education falls under this method. However, integrated subject knowledge is difficult to create, requires long-term verification, and it is a difficult method to access. The second way is for students to develop 'process knowledge' by encouraging them to have an open attitude and experience various activities. Many universities have chosen to operate using this method by providing educational activities that help students undergo various experiences of convergence inquiry through the process of problem solving; and in this way, naturally cultivating convergence knowledge.

Nonetheless, education to improve students' convergence competency must meet several conditions (Hong, 2016). Reinforcement of convergence capability must be reflected in the direction and goal of education to be justified. In addition, it is necessary to induce smooth exchange and interaction among professors who majored in Humanities, Natural engineering, Social sciences, and Arts. Fundamentally, it is necessary to develop the content and methods of liberal arts and major subjects to improve students' convergence competency. It is also necessary to develop extra-curriculum programs that allow for natural convergence experiences to take place. In particular, the educational content, teaching and evaluation methods must be organically linked in accordance with the learners' characteristics and educational purpose for improving convergence competency.

### 2.1.2 Concepts of Creative Competency and Improvement Way

Creativity is defined differently by scholars. Guilford (1967) sees creative thinking as divergent thinking and suggests that it is fluency, flexibility, originality, and elaboration as elements of divergent thinking. Fluency is the ability to produce as many ideas as possible in a particular problem situation without setting limits to thinking. Flexibility is the ability to find a variety of solutions by changing the conventional ways of thinking or perspectives. Originality refers to the ability to break away from the existing and produce unique and novel ideas. Elaboration is the ability to develop an existing idea that is unrefined into a more refined one (Lee, 2011). The definition of creativity which includes motivation, task obsession, persistence, and environmental factors has been raised recently by Urban (1995). However, the most common definition of creativity refers to the thinking and behavior that solves various problem situations in new and appropriate ways, and the ability to produce original output (Beghetto, 2016).

Creativity is a competency that every individual must have in the future society. Creativity, critical thinking, collaboration, and communication are the skills that students need to live in the 21st century society (Chon, 2017). For this reason, many universities strive to cultivate creative talents who will lead the fourth industrial revolution. However, creativity education in the university is conducted one-time in a short-term program, which does very little to help improve creativity. In addition, studies related to creativity have not been able to verify the effectiveness of the creativity improvement program in terms of personal effects and long-term changes (Lee, Park and Choe, 2012).

In order for educational activities to improve creative competency and help foster creative competency, several conditions must be met. Appropriate educational content, teaching methods and strategies for cultivating creative competency are required to foster creative competency (Hong and Yi, 2015). Educational content must consist of identifying problems to be solved, finding the cause of the problem accurately, and quickly implementing and evolving various ideas through cooperation with others. Also, one-sided lectures do not help students improve their educational satisfaction and creative competency. Subsequently, it is necessary to develop various educational methods and strategies, as well as create an educational environment that optimizes the effectiveness of creativity education through research on identifying learning factors that affect creativity (Bak, 2004).

## 2.2 Factors Affecting Convergence and Creative Competencies

### 2.2.1 Personal Factors Affecting Convergence and Creative Competencies

Previous studies viewed the factors affecting college students' convergence and creative capabilities as two main factors. The first is personal factors such as gender of the university students, pre-scores of convergence and creative competencies. Some studies reported that male students have higher creative competency than female students (Cho and Choi, 2019), and that there is no difference in creative competency according to gender (Kim and Lee, 2015). In the case of convergence competency, a study found that there is no difference in terms of gender (Cho and Choi, 2019).

On the other hand, it was found that there was a difference in creative and convergence competencies depending on the major (Cho and Choi, 2019; Lee and Lee, 2015; Pascarella and Terenzini, 2005). This study reported that based on Music college, the convergence capacity of Policy science college was the highest, followed by Teacher education, International departments, and Economics and finance colleges. But Natural science college was the lowest, followed by Engineering college. In addition, this study reported that based on Music college, Engineering college had the highest creative capabilities, followed by Life science, Policy science, Economics and finance, Teacher education, Business schools, Social science, Natural science, Humanities, Medical, and Nursing colleges.

Nevertheless, this study had the disadvantage of not being able to grasp the exact influence because students' prior competency scores were not included. And since convergence and creative capabilities vary by individuals, it is necessary to control differences within individuals in order to accurately grasp the differences between individuals (Hur and Park, 2021).

### 2.2.2 Educational Factors Affecting Convergence and Creative Competencies

The second factor influencing students' convergence and creative capabilities is educational factors i.e., educational satisfaction. Educational satisfaction is an individual's subjective and psychological judgment. It is a multifaceted and comprehensive perception and attitude of the various types of intangible services that students encounter in school (Choi, 2013). With reference to a study reported, educational services provided to students have a positive relationship with educational satisfaction (Lee, 2012), and it can be expected that changes in students' competencies may vary depending on the services provided by universities and their satisfaction with the services. Studies were found to report and support the prediction that core competencies improve when educational satisfaction is high (Kim, 2016; Kim, 2021; Park, Jung and Han, 2020). But, other studies reported that educational satisfaction does not

affect the core competencies of university students (Cho and Kim, 2018). Hence, consistent results have not been reported due to these contradictory findings.

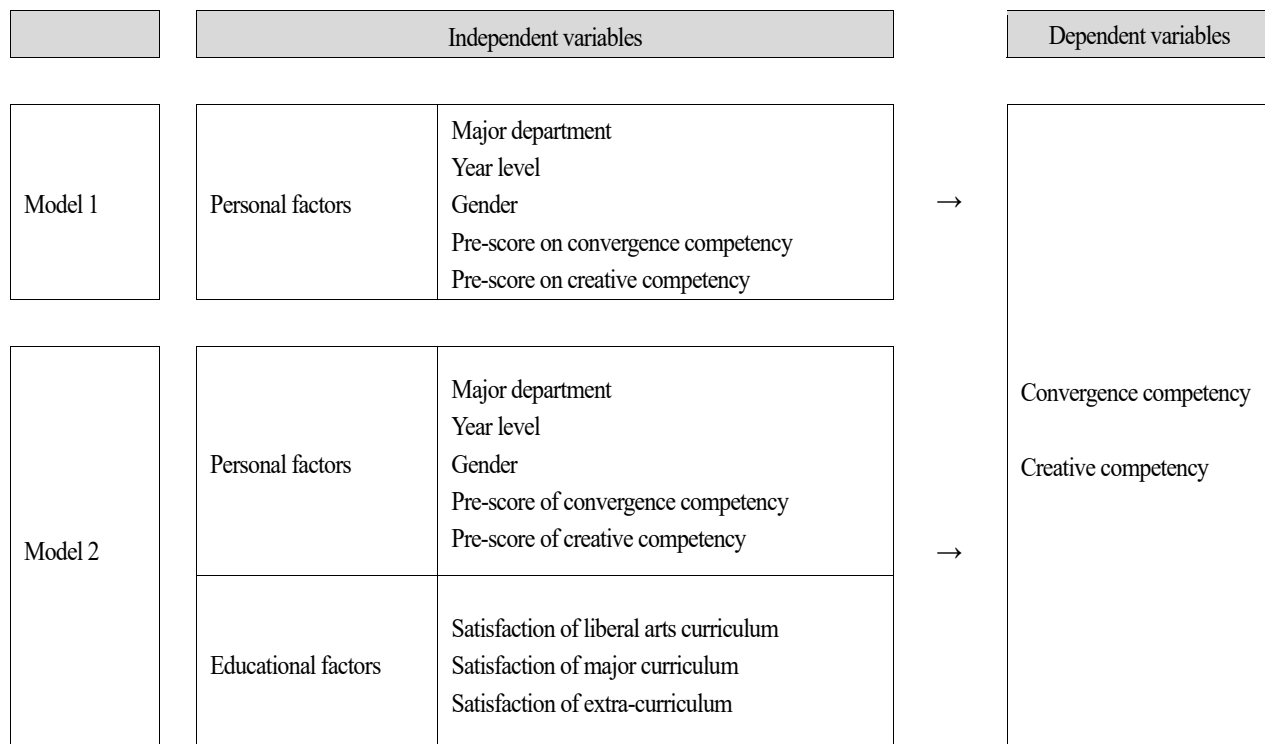
Furthermore, educational satisfaction is composed of several variables. A study claimed that educational satisfaction consists of educational content and classes, student guidance, educational environment, student support, university life, school image, and administrative services (Shin and Kwon, 2013). In addition, another study claimed that educational satisfaction consists of relationship with professors, quality of education, instructional guidance, and grade evaluation (Kwon, Oh and Park, 2002). This can be broadly divided into satisfaction with education and satisfaction with administrative services. Satisfaction with education is sub-divided into satisfaction with liberal arts, major, and extra-curriculum. The liberal arts, major, and extra-curriculum courses have completely different purposes and characteristics; thus, it is important to identify the satisfaction level separately (Hur and Ye, 2018). It is also important to analyze the impact on convergence and creative abilities since these are the learning outcomes.

Unfortunately, prior studies do not provide detailed implications for setting university education policies and strategies because education satisfaction had not been sub-divided into satisfaction with liberal arts, major, and extra-curriculum.

### 3. Research Methodology

#### 3.1 Design of Research

In order to compare and analyze the effects of personal factors as gender, year level, major, pre-score on convergence and creative competencies, and educational factors as satisfaction of liberal arts, major, and extra-curriculum on convergence and creative competencies, two models were designed as shown in <Figure 1>.



**Figure 1.** Design of Research

#### 3.2 Subjects of Research and Methods of Investigation

This study was conducted on 1,379 students attending N University in Chungcheongnam-do in 2021. Samples were selected by simple random sampling. This has the advantage of being unbiased because the sample was drawn at random, and the results obtained from the sample can be generalized. The general characteristics of the research subjects are shown in <Table 1>.

**Table 1.** General Characteristics of Research Subjects

Year	Gender	Engineering	Global and Business	Medical and Health	Arts and Sports	Total
		N(%)	N(%)	N(%)	N(%)	N(%)
1st	Male	70(5.10)	50(3.60)	42(3.00)	25(1.80)	187(13.60)
	Female	23(1.70)	60(4.40)	84(6.10)	67(4.90)	234(17.00)
	Total	93(6.70)	110(8.00)	126(9.10)	92(6.70)	421(30.50)
2nd	Male	24(1.70)	19(1.40)	7(0.50)	13(0.90)	63(4.60)
	Female	44(3.20)	74(5.40)	110(8.00)	52(3.80)	280(20.30)
	Total	68(4.90)	93(6.70)	117(8.50)	65(4.70)	343(24.90)
3rd	Male	26(1.90)	19(1.40)	12(0.90)	7(0.50)	64(4.60)
	Female	27(2.00)	55(4.00)	77(5.60)	31(2.20)	190(13.80)
	Total	53(3.80)	74(5.40)	89(6.50)	38(2.80)	254(18.40)
4th	Male	70(5.10)	36(2.60)	25(1.80)	11(0.80)	142(10.30)
	Female	29(2.10)	65(4.70)	82(5.90)	43(3.10)	219(15.90)
	Total	99(7.20)	101(7.30)	107(7.80)	54(3.90)	361(26.20)
Total	Male	190(13.80)	124(9.00)	86(6.20)	56(4.10)	456(33.10)
	Female	123(8.90)	254(18.40)	353(25.60)	193(14.00)	923(66.90)
	Total	313(22.70)	378(27.40)	439(31.80)	249(18.10)	1,379(100.00)

The university measured convergence and creative competencies of the new students at the beginning of March, and then measured convergence and creative competencies of all enrolled students at the end of the school year. It took 20-30 minutes to measure convergence and creative competencies, and 15-20 minutes to measure educational satisfaction. Before the competency diagnosis and satisfaction survey were conducted, consent was obtained from the students to participate in the survey. All tools of measurement were conducted using an online questionnaire system. The diagnosis scores of convergence and creative competencies and educational satisfaction scores were surveyed at the end of the year. In this way, the pre-scores and post-scores were compared, and were used as data to determine the progress of students.

### 3.3 Measurement Tools and Measurement Details

#### 3.3.1 Measurement Tool of Education Satisfaction

N University's educational satisfaction measurement tool was created by a development team involving a total of ten experts, including four internal professors, five external experts, and one foreign professor. In addition, the validity of the test tool was verified by conducting expert Delphi analysis, and exploratory and confirmatory factor analysis through preliminary investigation. The definition and sub factors of educational satisfaction are shown in <Table 2>.

**Table 2.** Definition and Sub Factors of Educational Satisfaction

Name	Definition	Name of sub factors	Definition of sub factors
Educational satisfaction	Satisfaction of a liberal arts curriculum, major curriculum, and extra-curriculum	Satisfaction of liberal arts curriculum	Degree to which the liberal arts curriculum is conducive to the development of basic knowledge
		Satisfaction of major curriculum	Degree to which major education meets social needs and helps prepare for future employment
		Satisfaction of extra-curriculum	Degree to which extra-activities help to adjust with college life

The educational satisfaction measurement tool consisted of 9 questions and was measured on a 5-point rating scale. Factor analysis was performed to verify the measurement tool. As a result of Bartlett's test, the approximate chi-square value was 9264.405 (df=36, p=0.00), and the KMO test value was 0.903 (p=0.00), indicating that the factor analysis was suitable. There were three factors with more than 1 of eigenvalue, and it was found that the three main components could explain 75.631% of the total variation. In addition, the Cronbach's  $\alpha$  value was 0.852 to

0.878, indicating high reliability. <Table 3> shows the results of factor analysis and reliability of the educational satisfaction measurement tool.

**Table 3.** Factor Analysis Results and Reliability of Educational Satisfaction Measurement Tool

No	Contents	Factor			Name	Reliability
		1	2	3		
1	Liberal arts classes are conducted at a high level according to the student's level.	0.835			Satisfaction of liberal arts curriculum	.852
2	The contents of liberal arts classes help create new values based on creativity.	0.720				
3	The liberal arts curriculum offers various lectures.	0.662				
4	Major classes are conducted at a high level according to the student's level.		0.857		Satisfaction of major curriculum	.878
5	The contents of the major class will be helpful for job performance after employment.		0.851			
6	Various lectures are offered in the major curriculum.		0.702			
7	There are opportunities to participate in various types of extra-curriculum programs.			0.768	Satisfaction of extra-curriculum	.873
8	The extra-program is conducted at a high level according to the student's level.			0.874		
9	The extra-activities are helpful to my college life.			0.877		

### 3.3.2 Convergence and Creativity Competencies Measurement Tools

The convergence and creative competency test questions were developed by one education administration major, one curriculum major, one education psychology major, one education evaluation major, one lifelong education major, four university teaching and learning center experts. The validity was verified through two preliminary surveys. Content validity and interest validity were calculated for I-CVR (Item-Content Validity Ratio). Content validity calculated the ratio of the total number of experts to experts who gave positive answers for each question, and interest validity calculated the ratio of the total number of students to the number of students who understood the sentence. If the I-CVR is 0.80 or more, the test questions were judged to be valid and adopted. The definition of convergence and creative competencies and sub factors are shown in <Table 4>.

**Table 4.** Definition of Convergence and Creative Competencies and Sub Factors

Name	Definition	Name of sub factors	Definition of sub factors
Convergence competency	Ability to collect and analyze information, to integrate and utilize diverse academic knowledge and skills	Integrative thinking	Ability to integrate and organize diverse knowledge and skills across interdisciplinary boundaries
		Use of information technology	Ability to collect, analyze, and evaluate data using information technology with a sense of information ethics and manage them comprehensively
Creative competency	Ability to actively address the contradictions and difficulties predicted through new and unique ideas	Sense of challenge	An aggressive attitude to seize and exploit opportunities despite future uncertainty
		Problem-solving ability	Ability to solve problems through new perspectives and logical thought processes in problem situations

The measurement tool on convergence and creative competencies consisted of 36 questions and was measured on a 5-point rating scale. Factor analysis was performed to verify the measurement tool. As a result of Bartlett's test, the approximate chi-square value was 57032.449(df=630, p=0.00), and the KMO test value was 0.986(p=0.00), indicating that the factor analysis was suitable. There were four factors with more than 1 of eigenvalue, and it was found that the four main components could explain 73.891% of the total variation. In addition, the Cronbach's  $\alpha$  value was 0.953 to 0.977, indicating very high reliability. <Table 5> shows the factor analysis results and reliability

of the convergence and creative competencies measurement tool.

**Table 5.** Factor Analysis Results and Reliability of Convergence and Creative Competencies Measurement Tool

No	Content	Factor				Sub factors	Competency	Reliability	
		1	2	3	4				
1	I can integrate the knowledge of various disciplines and apply it to the field.	0.707							
2	I am trying many ways to integrate various academic knowledge.	0.714							
3	I value the integration of knowledge for the creative effectiveness of various disciplines.	0.618							
4	I have the ability to analyze, to integrate the skills of various disciplines.	0.737							
5	I practice many ways to integrate various academic skills.	0.721				Integrative thinking			
6	I value actively converging various academic skills.	0.646							
7	I can integrate and systematize various academic knowledge and skills and apply them to the field.	0.731							
8	I can try many ways to organize various academic knowledge and skills.	0.722							
9	I value the systematization of various academic knowledge and skills.	0.654					Convergence competency	.977	
10	I know various sites where I can find the necessary knowledge and information.		0.627						
11	I can find new information through various media.		0.621						
12	I think other people's opinions or ideas are useful for collecting information.		0.744						
13	I can self-evaluate information in various systems or charts.		0.623						
14	I can draw conclusions based on information from various charts.		0.621			Use of information technology			
15	I think that each chart and statistic should be evaluated according to circumstances.		0.667						
16	I know how to efficiently synthesize information about topics of interest.		0.587						
17	I can integrate various information on topics of interest.		0.563						
18	I think it is important to comprehensively grasp the information.		0.698						
19	I know how to turn crisis into opportunity.			0.722					
20	I find the heart of the crisis, and I can turn it into an opportunity.			0.745					
21	I can be stronger through a crisis.			0.658		Sense of challenge	Creative competency	.973	
22	I know how to use a crisis to create opportunities.			0.728					
23	I can turn a crisis into a situation that can be exploited to create an opportunity.			0.751					

**Table 5.** Factor Analysis Results and Reliability of Convergence and Creative Competencies Measurement Tool (Continued)

No	Content	Factor				Sub factors	Competency	Reliability
		1	2	3	4			
24	I think the opportunity for growth comes from the crisis.			0.589				
25	I can evaluate whether a set goal is new and meaningful.			0.590				
26	I try and carry out unfamiliar methods to achieve my goal.			0.668				
27	I think it is important to experience new and valuable work.			0.733				
28	I know how to think creatively.				0.639			
29	I can connect and integrate various ideas.				0.593			
30	I think all problem solving is a challenge for my creativity.				0.594			
31	I can make an effective plan by linking all the information together.				0.513			
32	I can use all the alternatives to come up with a better solution to the problem.				0.548	Problem-solving Ability		
33	I think elaborating on the plan will produce a better solution to the problem.				0.626			
34	I know how to achieve my final goal through a good plan.				0.518			
35	I can solve problems by utilizing creative elements.				0.620			
36	I think all problems are solvable.				0.626			

### 3.4 Analysis Method

First, frequency analysis was performed to understand the characteristics of the research subject, and factor analysis and Cronbach's  $\alpha$  coefficient were confirmed to analyze the validity and reliability of the measurement tools. Second, the mean and standard deviation were calculated to determine the level of each independent and dependent variables. Third, multiple regression analysis was performed using the optimization scale method to understand the effects of individual and educational factors on convergence and creative competencies. The characteristics of the variables used in regression analysis are shown in <Table 6>. The preliminary scores of convergence and creative competencies were measured at the end of 2020. However, freshmen used the score measured in March 2021 as a pre-score. The follow-up scores of the dependent variables, convergence and creative competencies, were measured in December 2021.

Two regression models were designed to clearly compare the differences in the influence of individual and educational factors on convergence and creative competencies. Model 1 included only personal factors as independent variables, and Model 2 added educational factors. All independent variables of Model 1 and Model 2 were included in the regression equation using the simultaneous input method. Since this method shows the influence of a specific independent variable in a controlled state of other independent variables included in the regression equation, it has the advantage of being able to find the most influential variable. The correlation between variables is shown in <Table 7>, and the tolerance limit and variance expansion factors (VIF) are shown in <Table 10> and <Table 11>. Since the tolerance limit value is greater than 0.10 and the variance expansion factor is less than 10, it can be said that there is no collinear problem. All analyses used SPSS 24.0 for Windows.



**Table 6.** Characteristics of Variables Used in Regression Analysis

Variable group	Variable name	Types	Variable Description
Individual factors	Major department	Categorical type	Medical and Health (00)
			Engineering (01)
			Global and Business (10)
			Arts and Sports (11)
			1 <sup>st</sup> (11)
Individual factors	Year level	Categorical type	2 <sup>nd</sup> (10)
			3 <sup>rd</sup> (01)
			4 <sup>th</sup> (00)
			Male (0)
			Female (1)
Educational factors	Score of convergence competency	Continuous type	five-point scale
	Score of creativity competency	Continuous type	five-point scale
	Satisfaction of liberal arts curriculum	Continuous type	five-point scale
	Satisfaction of major curriculum	Continuous type	five-point scale
	Satisfaction of extra-curriculum	Continuous type	five-point scale

**Table 7.** Correlation of Research Variables

	Convergence competency	Creativity competency	Satisfaction of liberal arts curriculum	Satisfaction of major curriculum	Satisfaction of extra-curriculum	Total
Convergence competency	1					
Creativity competency	.909***	1				
Satisfaction of liberal arts curriculum	.383***	.355***	1			
Satisfaction of major curriculum	.375***	.361***	.825***	1		
Satisfaction of extra-curriculum	.288***	.293***	.649***	.620***	1	
Total	.388***	.375***	.916***	.904***	.860***	1

\* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$

**4. Results of Research**

*4.1 Level of Education Satisfaction and Convergence and Creativity Competencies*

4.1.1 Level of Education Satisfaction

The level of educational satisfaction of college students is shown in <Table 8>. Medical and Health colleges showed higher educational satisfaction than Engineering, Global and Business, Arts and Sports colleges. In general, the educational satisfaction of the 1st and 2nd year students was higher than that of the 3rd and 4th years, and the educational satisfaction of female students was higher than that of male students.

**Table 8.** Level of Educational Satisfaction by Prersonal Factors

		Satisfaction of major curriculum	Satisfaction of liberal arts curriculum	Satisfaction of extra-curriculum	Total
		M(SD)	M(SD)	M(SD)	M(SD)
Major department	Engineering	3.76 (0.80)	3.75 (0.77)	3.36 (0.83)	3.62(0.72)
	Global and Business	3.83 (0.73)	3.81 (0.75)	3.37 (0.84)	3.67(0.69)
	Medical and Health	4.11 (0.66)	4.00 (0.68)	3.68 (0.82)	3.93(0.64)
	Arts and Sports	3.80 (0.72)	3.72 (0.72)	3.48 (0.84)	3.66(0.66)
Year level	1st	3.98 (0.68)	3.87 (0.71)	3.49 (0.82)	3.78(0.64)
	2nd	3.97 (0.73)	3.94 (0.72)	3.56 (0.88)	3.82(0.70)
	3rd	3.85 (0.70)	3.81 (0.69)	3.48 (0.84)	3.71(0.66)
	4th	3.77 (0.82)	3.74 (0.81)	3.42 (0.84)	3.64(0.75)
Gender	Male	3.80 (0.81)	3.76 (0.80)	3.49 (0.86)	3.68(0.76)
	Female	3.95 (0.69)	3.88 (0.70)	3.49 (0.84)	3.77(0.65)
Total		3.90 (0.74)	3.84 (0.74)	3.49 (0.84)	3.74(0.69)

4.1.2 Level of Convergence and Creativity Competencies

The level of convergence and creative competencies of college students is shown in <Table 9>. The convergence and creative competencies of Medical and Health college students was higher than that of Engineering, Global and Business, and Arts and Sports colleges. The convergence and creative competencies of the 2nd and 3rd year students was higher than that of the 1st and 4th years, and the convergence and creative competencies of female students was higher than that of male students.

**Table 9.** Level of Convergence and Creativity Competencies by Personal Factors

		Integrative thinking	Use of information technology	convergence competency	Sense of challenge	Problem-solving ability	creativity competency
		M(SD)	M(SD)	M(SD)	M(SD)	M(SD)	M(SD)
Major department	Engineering	3.72 (0.74)	3.78 (0.72)	3.75 (0.71)	3.72 (0.74)	3.73 (0.74)	3.73 (0.73)
	Global and Business	3.72 (0.77)	3.80 (0.74)	3.76 (0.74)	3.75 (0.76)	3.75 (0.76)	3.75 (0.74)
	Medical and Health	3.82 (0.72)	3.93 (0.67)	3.88 (0.67)	3.84 (0.69)	3.81 (0.69)	3.82 (0.67)
	Arts and Sports	3.65 (0.67)	3.77(0.65)	3.71 (0.64)	3.66 (0.69)	3.69 (0.69)	3.68 (0.67)
Year level	1st	3.68 (0.71)	3.83 (0.65)	3.75 (0.65)	3.74 (0.70)	3.73 (0.69)	3.73 (0.67)
	2nd	3.83 (0.70)	3.93 (0.66)	3.88 (0.66)	3.81 (0.68)	3.81 (0.70)	3.81 (0.67)
	3rd	3.75 (0.73)	3.80 (0.70)	3.78 (0.69)	3.77 (0.72)	3.77 (0.72)	3.77 (0.70)
	4th	3.72 (0.78)	3.77 (0.78)	3.74 (0.77)	3.71 (0.78)	3.72 (0.79)	3.72 (0.76)
Gender	Male	3.67 (0.77)	3.74 (0.75)	3.70 (0.74)	3.73 (0.76)	3.70 (0.77)	3.72 (0.75)
	Female	3.77 (0.71)	3.88 (0.67)	3.83 (0.67)	3.77 (0.70)	3.78 (0.70)	3.77 (0.68)
Total		3.74 (0.73)	3.83 (0.70)	3.79 (0.70)	3.76 (0.72)	3.75 (0.72)	3.75 (0.70)

4.2 Educational Satisfaction Factors Affecting Convergence and Creative Competencies

4.2.1 Educational Satisfaction Factors Affecting Convergence Competency

<Table 10> shows the results of regression analysis of Model 1 and Model 2 to explore the factors affecting the convergence capability. It can be seen that model 2 has a greater explanatory power of 23.3% than model 1's explanatory power of 13.6%, so F-value of model 2 (F=47.573, p=0.000) is also larger than model 1 (F=37.282,

p=0.000). Therefore, this study attempts to choose Model 2. Furthermore, Model 2 shows the decreased influence of individual factors (that are difficult for the university to intervene) when educational factors that the university could intervene are added. This means that by increasing the satisfaction of liberal arts and major education, the influence of individual factors can be reduced. In particular, it was found that satisfaction with the major curriculum had greater effect on convergence competency than satisfaction with the liberal arts curriculum.

**Table 10.** Educational Satisfaction Factors Affecting Convergence Competency

coefficient		Dependent variable (Convergence competency)									
		Model 1					Model 2				
		β	S.R.	β	t	β	S.R.	β	t	tolerance	VIF
Constant		2.508	0.101		24.835***	1.509	0.121		12.437***		
Individual factors	Major department 1	-0.066	0.035	-0.047	-1.867	-0.021	0.033	-0.015	-0.620	.976	1.024
	Major department 2	-0.075	0.036	-0.053	-2.067*	-0.017	0.034	-0.012	-0.506	.948	1.055
	Year level 1	0.016	0.036	0.011	0.445	-0.026	0.034	-0.018	-0.760	.959	1.042
	Year level 2	-0.051	0.035	-0.037	-1.443	-0.058	0.033	-0.042	-1.739	.968	1.033
	Gender	0.094	0.038	0.064	2.472*	0.064	0.036	0.043	1.779	.937	1.067
	Pre-score of convergence	0.354	0.025	0.354	14.042***	0.282	0.024	0.282	11.585***	.937	1.067
	Satisfaction of major curriculum					0.176	0.041	0.187	4.339***	.300	3.336
Educational factors	Satisfaction of liberal arts curriculum					0.123	0.041	0.131	2.976**	.288	3.476
	Satisfaction of extra-curriculum					0.029	0.026	0.036	1.121	.551	1.815
Model Description and Fit		Modified R <sup>2</sup> =0.136 F=37.282(p=.000)				Modified R <sup>2</sup> =0.233 F=47.573(p=.000)					

\*p<0.05, \*\*p<0.01, \*\*\*p<0.001

#### 4.2.2 Educational Satisfaction Factors Affecting Creative Competency

<Table 11> shows the results of regression analysis of Model 1 and Model 2 to search for factors affecting creative competency. It can be seen that model 2 has greater explanatory power of 22.3% than model 1's explanatory power of 13.6%, so F-value of model 2 (F=44.848, p=0.000) is also larger than model 1 (F=37.151, p=0.000). Therefore, this study attempts to choose Model 2. Furthermore, Model 2 shows the decreased influence of individual factors (that are difficult for the university to intervene) when educational factors that the university could intervene are added. This means that by increasing the satisfaction of liberal arts and major education, the influence of individual factors can be reduced. In particular, it was found that satisfaction with the liberal arts curriculum had greater effect on creative competency than satisfaction with the major curriculum.

**Table 11.** Educational Satisfaction Factors Affecting Creative Competency

coefficient	Dependent variable (Creative competency)										
	Model 1					Model 2					
	$\beta$	S.R.	$\beta$	t	$\beta$	S.R.	$\beta$	t	tolerance	VIF	
Constant	2.492	0.100		25.010***	1.532	0.122		12.564***			
Individual factors	Major department 1	-0.051	0.036	-0.036	-1,435	-0.006	0.034	-0.005	-0.188	.978	1.023
	Major department 2	-0.081	0.036	-0.057	-2.227*	-0.027	0.035	-0.019	-0.768	.947	1.055
	Year level 1	-0.028	0.036	-0.020	-0.790	-0.063	0.034	-0.045	-1.847	.955	1.047
	Year level 2	-0.016	0.036	-0.011	-0.435	-0.021	0.034	-0.015	-0.624	.999	1.033
	Gender	0.043	0.038	0.029	1.118	0.015	0.037	0.010	0.409	.937	1.067
	Pre-score of creative	0.362	0.025	0.367	14.543***	0.294	0.024	0.298	12.120***	.934	1.070
	Satisfaction of major curriculum					0.130	0.041	0.136	3.142**	.300	3.333
	Satisfaction of liberal arts curriculum					0.138	0.042	0.145	3.283***	.287	3.478
Satisfaction of extra-curriculum					0.049	0.027	0.058	1.825	.550	1.817	
Model Description and Fit	Modified R <sup>2</sup> =0.136 F=37.151(p=.000)				Modified R <sup>2</sup> =0.223 F=44.848(p=.000)						

\*p<0.05, \*\*p<0.01, \*\*\*p<0.001

### 5. Discussion and Conclusion

The purpose of this study was to understand the effects of individual and educational factors on convergence and creative competencies of university students. In order to achieve the research purpose, educational satisfaction and creativity and convergence capabilities were measured among 1,379 students in 2021, and multiple regression analysis was conducted using the optimization scale method.

The findings are as follows. First, the educational satisfaction of the students from the Medical and Health college was higher than the students from Engineering, Global and Business, and Arts and Sports colleges. Also, the educational satisfaction of the 1st and 2nd year students was higher than that of the 3rd and 4th years; and the educational satisfaction of the female students was higher than that of the male students. In addition, the convergence and creative competencies of students from the Medical and Health college were higher than those from the Engineering, the Global and Business, Arts and Sports colleges. The results of this study are the same as those studies that reported differences in creative and convergence capabilities according to majors (Cho and Choi, 2019; Lee and Lee, 2015; Pascarella and Terenzini, 2005). However, there were differences in specific results. Previous studies reported that Engineering students had the highest creative ability and Policy science students had the highest convergence ability, but this study differs in the sense that the convergence and creative abilities of Medical and Health students are the highest.

Furthermore, the convergence and creative competencies of the 2nd and 3rd year students were higher than that of the 1st and 4th years, and the convergence and creative competencies of female students was higher than that of male students. These results differ from the study reported that male students had higher creative ability than female students, but there was no difference in the convergence competency between male and female students (Cho and Choi, 2019). Also, this study is different from the study reported that was no difference in creative ability according to gender (Kim and Lee, 2015).

Second, it was found that if educational satisfaction, which is an educational factor that can be managed by a university is high, then the influence of individual factors on the convergence and creative competencies can be

reduced. This result is different from the study reported that educational satisfaction did not affect the core competencies of college students (Cho and Kim, 2018). However, this result is the same with the study reported that the improvement of the core competencies of students had a positive relationship with satisfaction of university education service (Lee, 2012), and with the study reported that core competencies improved greatly when the education satisfaction was high (Kim, 2016; Kim, 2021; Park, Jung and Han, 2020). It can be surmised that the influence of education satisfaction on core competencies was verified.

Moreover, it was found that satisfaction with the extra-curriculum did not affect convergence and creative competencies, but satisfaction with the liberal arts curriculum and major curriculum had an effect on convergence and creative competencies. In particular, it was found that satisfaction with the major curriculum had greater influence on convergence competency, and satisfaction with the liberal arts curriculum had greater influence on creative competency. These results show that, in terms of curriculum satisfaction, the influence of extra-curriculum and subject curriculum satisfaction on convergence and creative competency improvement is different. It also shows that although the subject curriculum is the same, liberal arts and majors have different influences on convergence and creativity competencies. In the end, the results of this study support the argument that college education needs to be categorized separately according to three types of curriculum satisfaction because college education is conducted through a combination of liberal arts, major, and extra-curriculum courses with completely different purposes and characteristics (Hur and Park, 2021).

Based on the research results, the following strategies are recommended as necessary in order to improve the convergence and creative capabilities of university students. First, universities must strive to improve the competencies of the Engineering, Global and Business, and Arts and Sports colleges with relatively low convergence and creative competencies, and to improve the competencies of the 1st and 4th year students and the male students as well. Second, in order to improve convergence competency, satisfaction with the major curriculum must be increased. And in order to improve creative competency, satisfaction with the liberal arts curriculum must be increased. To this end, universities must open various liberal arts and major subjects, and maintain a high level of quality according to the level of students. Additionally, liberal arts subjects' content must be directed towards improving creativity, and major subjects' must be focused on improving job performance for employment.

However, this study was intended for students from only one university. In the future, it is necessary to conduct an expanded research to include research subjects nationwide in order to generalize the research results to the university student population in South Korea. Lastly, it is necessary to explore educational factors that affect the amount of change in convergence and creative competencies through the accumulation of data for future longitudinal studies.

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